THE
JOURNAL OF MENTAL SCIENCE

[Published by Authority of the Royal Medico-Psychological Association.]

No. 403 [NEW SERIES No. 367] APRIL, 1950. VOL. XCVI

Part I.—Original Articles.

THE RH FACTOR: ITS ROLE IN HUMAN DISEASE, WITH PARTICULAR REFERENCE TO MENTAL DEFICIENCY.*

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[Received 6 February, 1950.]

MANY workers on both sides of the Atlantic have done intensive work on the Rh factor since its discovery was first published in 1940. The great majority of these workers have been concerned essentially with its influence on physical disease, the mental aspects being either ignored entirely or only lightly touched upon.

Recent work in America, however, has suggested that possibly the Rh factor may play an important part in the aetiology of some cases of mental deficiency, at present of unknown origin. The large number of cases of mental deficiency lends urgency to any research which will throw light on the cause of this distressing condition, as prophylaxis is even more essential in mental deficiency than in most other forms of disease. If a means of preventing even a small proportion of the present number of defectives from being born could be found, the results would be well worth while from an economic and social point of view, apart altogether from the avoidance of the distress caused to parents who have the misfortune to produce a mentally defective child.

EARLY THEORIES ON INCOMPATIBILITY OF FOETAL AND MATERNAL BLOOD.

The history of the development of the iso-immunization theory in relation to the Rh factor as the cause, in the vast majority of cases, of erythroblastosis foetalis and its sequelae is extremely interesting in that it shows how the truth was anticipated long before it was actually proved.

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*Adapted from a Thesis for the M.D. Degree, accepted by the University of Edinburgh.

McQuarrie (1923) suggested there was a relationship between the incompatibility of maternal and foetal blood on the one hand and the development of eclampsia, or pre-eclamptic toxaemia, on the other. He proved that in 23·3 per cent. of the cases he studied the mother's serum agglutinated her own infant's red cells. The incompatibility referred, of course, to the ordinary blood groups.

Stimulated by this article Ottenburg (1923), also writing on eclampsia, referred to the work of Dienst in 1906. Dienst injected methylene blue solution into the umbilical artery or vein of the still attached placenta of women at the end of childbirth. In some of these women the dye appeared in the urine in considerable amount, and Ottenburg said that Dienst interpreted this as meaning there was a communication between the circulation of the mother and the child. Dienst also found that in a proportion of cases the mother's serum agglutinated the red cells of her own child. He propounded the theory, Ottenburg continued, that eclampsia was nothing but a transfusion of incompatible blood of the child into the mother's circulation as a result of a communication between the two. Ottenburg then said that later Dienst retracted his idea but that he, Ottenburg, was convinced it was correct. Ottenburg finally suggested the idea that several other unexplained diseases, especially jaundice of the newborn, might also be due to accidental placental transfusion of incompatible blood.

The same theory was also put forward by Darrow (1938). She showed how icterus gravis neonatorum could be linked up on the one hand with the severer condition of hydrops foetalis, and on the other with the milder one of congenital (idiopathic) anaemia, owing to the familial association of the three conditions. (Erythroblastosis foetalis, or, alternatively, haemolytic disease of the newborn, is the general term now used to denote these three diseases). Darrow tentatively suggested that the red cells of the infant are destroyed by the action of specific immune bodies, and she thought that foetal haemoglobin might be immunologically different from adult haemoglobin, and thus be the antigen involved.

Intra-group Agglutination.

Levine and Stetson (1939) reported an unusual case of intra-group agglutination, and put forward a theory to account for it. A woman having her second pregnancy developed signs of toxaemia, and was delivered of a macerated stillborn foetus. She was transfused with whole blood from her husband, both being group O, and ten minutes later she developed a chill and complained of pains in the legs and head. An irregular agglutinin was found in her blood, and out of 54 group O bloods, 13 only failed to react with her serum. The reactions were independent of the M, N, or P factors. The authors then expressed the view that since the patient had harboured a dead foetus for several months, it could be assumed that the products of the disintegrating foetus were responsible not only for the toxic symptoms of the patient, but also for her iso-immunization. They presumed that the immunizing property in the blood and/or the tissues of the foetus must have been inherited from the father, but they could not identify it.

Wiener and Peters (1940) described accidents following repeated intra-group transfusions, and then stated there were some reports of intra-group haemolytic reactions in patients who had never previously received a blood transfusion. They pointed out that these patients were women who had recently given birth to a child or had had a miscarriage. Thus was founded the suspicion that the two conditions might have a common aetiology.

DISCOVERY OF THE RHESUS FACTOR.

In their epoch-making article, Landsteiner and Wiener (1940) first published their discovery of a new factor in human blood. This factor, because of its identity with a similar one already found by them to be present in the blood of Rhesus monkeys, they called the Rhesus Factor. It was found to be independent of the ABO group, the MN type, or the property P. In a second article (1941) these writers stated that this factor was found to be present in 85 per cent. of the cases they had examined, taken from the white population of America.

They then said that evidence of the clinical importance of this discovery was obtained when blood samples were got from patients who had shown haemolytic reactions after receiving repeated transfusions of blood of the proper group. The sera of these patients contained anti-Rh iso-agglutinins, while in the blood cells the factor was lacking. This proved that the antigen in question was able to induce the formation of immune iso-antibodies in certain human beings.

As a result of studies on heredity, these authors concluded that the property Rh was inherited as a dominant, not sex-linked, and they presumed it was transmitted by means of a pair of genes, Rh and rh, where the dominant gene Rh determines its presence. From this they concluded that three genotypes would exist, RhRh, Rhrh, and rhrh, the first two corresponding to the phenotype Rh-positive, and the third to the phenotype Rh-negative.

This work of Landsteiner and Wiener was quickly confirmed. In Britain, Boorman, Dodd and Mollison (1942) examined 1,610 people in the general population and found that 85·15 per cent. were Rh-positive and 14·85 per cent. were Rh-negative. Hoare (1943) tested 1,122 cases in South Wales and found 84·6 per cent. were Rh-positive. Cappell (1944), working in Dundee and district, found that in 3,000 cases 84·5 per cent. were Rh-positive. It was soon generally accepted that in the white population 85 per cent. are Rh-positive and 15 per cent. are Rh-negative to the original guinea-pig anti-serum used by Landsteiner and Wiener, and the corresponding standard human anti-serum.

COMPLEXITY OF THE RH FACTOR.

It was soon found, however, that the Rh factor was indeed a complex structure. The whole subject has become extremely complicated, and it is not necessary for the present study to discuss in detail the intricacies of the Rh factor as it is now known. For this reason only a short outline, based mainly on Cappell (1946, 1948) will be given.

In the course of testing large numbers of people, four types of anti-serum, each containing a single agglutinin, were found comparatively soon, and by means of these sera seven types of Rh complex were distinguished, while an eighth very rare type was believed on theoretical grounds to exist. It was as a result of Fisher's interpretation of the situation (see below) that the existence of this rare eighth type, and also of two other anti-sera, was predicted. The Rh types were named Ro, R1, R2, Rz, R′, R″, Ry and rh. The first four were all Rh-positive and the latter four all Rh-negative according to their reactions with the original guinea-pig anti-Rhesus serum, and Cappell agrees with Wiener's suggestion that the four negative types should be designated by the small letters r′, r″, ry and rh. The ry type was the one believed to exist, and it has only recently been found, as described by van den Bosch (1948).

The genotype of each individual represents the sum of two Rh types, one derived from each parent. The Rh genes are carried on a chromosome pair different from those bearing the ABO, the MN, the P, and all the other blood group genes. The eight Rh types give rise to 36 possible genotypes. It was difficult to understand the various serological results that were being obtained in practice until Fisher interpreted the Rh phenotype as the sum of three closely linked pairs of allelomorphic genes, which he designated by the letters Cc, Dd, and Ee. Each of the six letters indicates a distinctive antigen in the red cell, and the triple-gene-complexes give rise to the eight theoretical Rh types.

The relationship between Wiener's nomenclature and Fisher's is shown as follows:

Rh positive types
Ro — cDe
R1 — CDe
R2 — cDE
Rz — CDE

Rh negative types
r′ — Cde
r″ — cdE
ry — CdE
rh — cde

Corresponding anti-sera to all the above antigens have now been discovered as it was predicted by Fisher that they would.

One point to which special attention should be drawn is the fact that the negative quality rh is not simply an absence of the positive factor Rh but is an entity in itself. Of the four subdivisions of rh, about 2 per cent. of people (Cappell, 1945) have the sub-types r′ (Cde) or r″ (cdE) in their blood, and are not completely negative rhrh (cde, cde). These sub-types, r′ and r″ do react with certain anti-sera (anti-C and anti-E respectively), and some workers for this reason have included these subgroups with the Rh positive series.

As Cappell pointed out, however, such individuals, since they do not have the D antigen, will be liable to develop anti-D as easily as a completely Rh-negative individual would. The D antigen is much the most potent and frequent cause of iso-immunization, either in intra-group transfusions or in pregnancy, and for these purposes, therefore, such women should be regarded as Rh-negative. In the present investigation, it was therefore decided to include amongst the Rh-negative group any such cases found.

RELATIONSHIP OF RH ISO-IMMUNIZATION TO ERYTHROBLASTOSIS FOETALIS.

Meantime, Levine and his colleagues were pursuing their investigations. Levine and Katzin (1940) and Levine, Katzin and Burnham (1940) gave further evidence in support of the theory that a mother may be immunized by her foetus, or the foetal parts of the placenta. They found a "warm" agglutinin which was similar to the anti-Rh of Landsteiner and Wiener (1940), and they believed that the foetus inherits certain dominant agglutinable substances from the father which, if lacking in the mother, may stimulate her to produce iso-antibodies.

Levine, Katzin and Burnham (1941) found atypical agglutinins in three patients who had given birth to infants suffering from erythroblastosis foetalis and who also had obstetric complications. They suggested that there was a connection between the occurrence of these complications and the presence of immune agglutinins in the mother. They stated that this relationship lent itself readily to form a theoretical basis for the aetiology of at least some cases of erythroblastosis foetalis. The hypothesis of iso-immunization, they said, could readily explain the familial incidence of this condition and also the blood picture characteristic of it. It was assumed by them that the agglutinins in the mother's circulation under certain conditions were able to penetrate the placental barrier. There was sufficient evidence to show that most of these sera contained an agglutinin similar to the anti-Rh agglutinin of Landsteiner and Wiener.

Levine (1941) suggested that anti-Rh agglutinins were responsible for about 90 per cent. of all intra-group transfusion accidents, either after repeated transfusion or in pregnancy at the first transfusion. He also suggested that erythroblastosis foetalis is the result of (1) iso-immunization of the Rh-negative mother by the Rh-positive blood of the foetus, and (2) the subsequent passage of the mother's agglutinins through the placenta to act on the susceptible blood of the foetus.

Burnham (1941) described cases linking up the common aetiology of erythroblastosis foetalis and transfusion accidents in pregnancy. In his own recent series of 1,400 deliveries there were eight cases, although previously the incidence of erythroblastosis was given as 1 : 2,000 births. He admitted, however, that six of these cases would have been missed if they had not been specially looked for.

Levine, Burnham, Katzin and Vogel (1941) reported that of 153 mothers who were delivered of one or more infants suffering from one of the three clinical forms of erythroblastosis foetalis, 93 per cent. were Rh-negative. Eighty-nine husbands and 76 affected infants in the series of Rh-negative mothers were tested, and they were 100 per cent. Rh-positive, the figure anticipated if the theory were correct. Anti-Rh agglutinins were present in 42 out of the 141 Rh-negative mothers, in 33 of whom the blood was examined within two months of labour.

CONFIRMATION OF THE ISO-IMMUNIZATION THEORY.

The relationship of Rh iso-immunization to erythroblastosis foetalis was soon confirmed. Boorman, Dodd and Mollison (1942) showed that out of 48 cases of the disease 96 per cent. of the mothers were Rh-negative, and all the infants were Rh-positive. Race, Taylor, Cappell and McFarlane (1943) found that in 50 cases 88 per cent. of the mothers were Rh-negative; Plaut *et al.* (1945) found 88·2 per cent. Rh-negative mothers in 136 cases; and Cappell (1946) reported 86 per cent. Rh-negative mothers in 114 cases of the disease. In all these series a high proportion of the Rh-negative mothers had Rh antibodies in their sera.

It has thus been proved that in about 90 per cent. of cases, erythroblastosis foetalis is due to Rh incompatibility between the mother and foetus, with the resultant iso-immunization of the mother's serum by the Rh antigen in the red cells of the foetus.

That iso-immunization can also occasionally occur due to a difference in the ordinary blood groups of mother and infant (hetero-specific pregnancy) has been shown by several workers: Boorman, Dodd and Mollison (1944); Polayes and Ohlbaum (1945); Aubert, Cochrane and Ellis (1945); Austin and Smith (1946).

FACTORS INFLUENCING THE SEVERITY OF ERYTHROBLASTOSIS FOETALIS.

Levine, Burnham, Katzin and Vogel (1941) continued their article by stating that it was the continuous intra-uterine action of anti-Rh agglutinins on the Rh-positive foetal blood, over a period varying from weeks to months, which caused the progressive haemolysis of the foetal blood. The wide variety of clinical syndromes they suggested was probably the result of the varying degree and duration of iso-immunization during pregnancy. In this connection, Stratton (1943) and Cappell (1946) have shown that it is theoretically possible in some cases for an Rh-negative mother to be subject to the influence of the Rh antigen of her foetus over a period as long as six months.

Davidsohn (1945) considered that four factors may influence the severity of this condition:

(1) Age of foetus when Rh antobodies begin to act on it.
(2) Length of time during which foetus is exposed to such action.
(3) Strength of the Rh antibodies.
(4) Permeability of the placenta.

The "blocking" antibody of Wiener (1944), or, what is the same thing, the "incomplete" antibody of Race (1944), if present in the mother's serum, is now recognized to result in the most severe form of foetal disease—hydrops foetalis (Cappell, 1946).

THEORIES REGARDING THE CLINICAL FORMS OF ERYTHROBLASTOSIS FOETALIS.

The clinically observed fact that some infants were born apparently free of the condition but in the course of a few days developed severe anaemia or jaundice was puzzling. Levine *et al.* suggested that the tissues of the foetus stored the mother's agglutinins and the subsequent release of these could then induce haemolysis several days after birth. Levine (1943) commenting on this said it would involve the simultaneous presence of maternal anti-Rh agglutinin and its corresponding antigen in the blood stream of the affected infant, a rarely observed fact.

Wiener (1945*b*) thought that a third factor, X protein, might be responsible. He believed it to be important for *in vivo* haemolysis in cases where " blocking " antibodies were present, but Cappell (1946) criticized this theory on the grounds that in these cases the foetus often fails to reach full term and is commonly stillborn prematurely.

Wiener, Wexler and Grundfast (1947) suggested that a difference in the quality of antibody produced by the mother resulted in the different forms of the disease. They postulated two types of antibody, univalent and bivalent, the first passing the placental barrier during the last third of pregnancy, and the second mainly during parturition. In this case the infant at delivery often seems normal, and then may suddenly die without developing anaemia.

Cappell (1947) on the other hand said that the type of foetal disease could not be predicted with certainty from the nature and titre of maternal ante-natal Rh antibodies, beyond the general statement that a high concentration is likely to be associated with a fatal hydrops foetalis.

Skelton and Tovey (1945) believed that the absence of jaundice at birth was due to the fact that foetal bilirubin is excreted by the mother. The liver damage becomes manifest at birth, however, and jaundice develops shortly afterwards. Mollison and Cutbush (1949) showed that the haemoglobin value in the cord blood of an infant with haemolytic disease is well correlated with its severity.

HEREDITARY NATURE OF ERYTHROBLASTOSIS FOETALIS.

Levine, Burnham, Katzin and Vogel (1941) concluded their article by stating the hereditary nature of this disease in terms of the iso-immunization theory. In some families every pregnancy is affected, except perhaps the first, while in others only some of the pregnancies are affected. Since the Rh factor is inherited as a simple mendelian dominant, the striking difference in the familial incidence of the disease is determined, genetically, by the homozygosity (RhRh) or heterozygosity (Rhrh) of the father's blood.

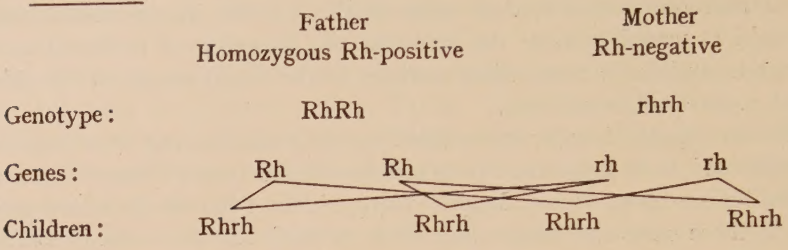
The diagram on p. 366 illustrates the above conception.

The homozygous father can produce only heterozygous Rh-positive children, whereas the heterozygous father may have 50 per cent. of his children Rh-negative, these escaping the disease.

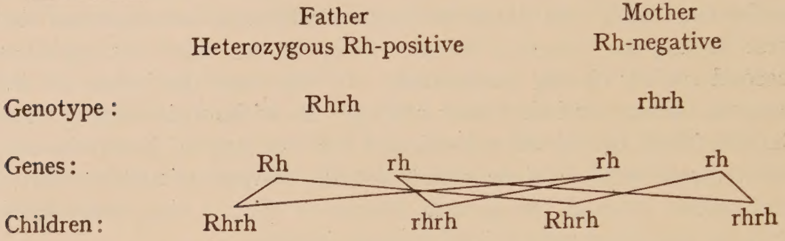
FACTORS INFLUENCING THE INCIDENCE OF ERYTHROBLASTOSIS FOETALIS.

Snyder *et al.* (1945*a*) said that the effects of Rh incompatibility could be expected in 6 per cent. of pregnancies, but that it occurred only in 0·5 per cent. Similarly, Cappell (1946) said that Rh incompatibility occurred in 10 per cent of pregnancies, but that sensitization occurred only in 1 : 25 opportunities, giving an incidence of 1 : 250 for the occurrence of haemolytic disease.

Example 1.


Father
Homozygous Rh-positive
Mother
Rh-negative
Genotype:
RhRh
rhrh
Genes:
Rh
Rh
rh
rh
Children:
Rhrh
Rhrh
Rhrh
Rhrh

Example 2.


Father
Heterozygous Rh-positive
Mother
Rh-negative
Genotype:
Rhrh
rhrh
Genes:
Rh
rh
rh
rh
Children:
Rhrh
rhrh
Rhrh
rhrh

This discrepancy has given rise to many theories to account for it. Taylor and Race (1944) and Cappell (1946) showed that the mating of a homozygous Rh-positive man with an Rh-negative woman has a much greater chance of producing an erythroblastotic baby than the mating of a heterozygous Rh-positive man with an Rh-negative woman, this chance being in addition to the points noted in the previous section of the present paper.

To explain the fact that some women are more sensitive than others to the Rh antigen, while some are not affected by it at all, Cappell (1946), quoting Race, said there was evidence that this aptitude to become immunized may also be an inherited character. Unger and Wiener (1945) also believed this and thought, in addition, that the wide spacing of a few pregnancies was more apt to give rise to sensitization than a larger number within a shorter period of time. This point was stressed by Young and Kariher (1945), while Mollison (1943) believed that the factors to be considered were (1) failure of the Rh antigen to cross the placenta in adequate amount, and (2) failure of the mother to respond to the stimulus of the Rh antigen.

Another factor of importance is the compatibility or otherwise of the ABO groups of the mother and foetus. Race, Taylor, Cappell and McFarlane (1943) thought that in their series of cases of haemolytic disease the proportion of homospecific pregnancies was higher than normal, although their records were incomplete. Cappell (1946) in an analysis of the table given by Plaut *et al.* (1945), showed that there was a significant deficiency of group O mothers, and an excess of group A; whereas it was the reverse amongst the husbands. Also the number of homospecific pregnancies was higher than normal. Cappell also found the same unduly high number of homospecific pregnancies in his own series of cases. Wiener (1945*a*) noticed the same thing and thought it was due to the fact that the properties A and B were good antigens whereas the property Rh was not ; hence when the ABO groups are compatible the Rh-negative mother is more likely to become sensitized to the Rh antigen than when they are not.

CLINICAL MANIFESTATIONS OF ERYTHROBLASTOSIS FOETALIS.

According to Cappell (1946) this disease should be suspected when jaundice appears within a few hours of birth, although it may be delayed up to 48 hours. Rapidly deepening jaundice, accompanied by drowsiness and a failure to feed satisfactorily is highly suspicious. The haemoglobin and the red cells are both reduced, although reticulocytes are numerous and normoblasts, megaloblasts and primitive cells are all present, the latter being specially significant. Skelton and Tovey (1945) showed that biliary obstruction in children with icterus gravis may take one of two forms : a blockage of one of the larger bile ducts with inspissated bile, or conversion of the bile ducts into a fibrous cord. They believed that certain cases of so-called " congenital " obliteration of the bile ducts occur as a sequel of icterus gravis.

Drummond and Watkins (1946) thought that certain cases of hepatomegaly and splenomegaly in children and adolescents could result from haemolytic disease of the newborn, and they emphasized that Rh incompatibility must be excluded in the diagnosis.

RELATIONSHIP OF ERYTHROBLASTOSIS FOETALIS TO KERNICTERUS.

This relationship was clearly brought out by Zimmerman and Yannet (1933). They stated that " kernicterus " was a term coined by Schmorl in 1903 to designate jaundice of various nuclear masses of the brain, but that it was Orth who, in 1875, first described the condition. The structures most commonly affected in this disease are the caudate, lentiform, subthalamic and dentate nuclei ; the thalami, mammillary bodies, cornu ammonis, and the nuclei of the cranial nerves ; the olives, and even parts of the cerebellar cortex, as well as the anterior and posterior horns of the spinal cord. The writers said that jaundice of these structures was not a disease *sui generis*, but occurred as one of the lesions that could be found in newborn infants with severe jaundice, and only in a small number of these. In other words, kernicterus is most frequently, if not exclusively, associated with icterus gravis neonatorum. In support of their statement, they described four cases of their own, and compared kernicterus with Wilson's disease (progressive lenticular degeneration). They believed septic infection to be the most likely cause of icterus gravis, although they admitted this did not explain, for example, the familial incidence of the disease.

Hawksley and Lightwood (1934) described the symptoms of kernicterus, the presence of which has been proved pathologically. They are : drowsiness and apathy, convulsions, spasticity and signs of medullary failure. Paralysis of the vital medullary centres is the usual mode of death, but they said that the condition occurs comparatively rarely in icterus gravis, and quoted Schmorl who found six cases in 120 autopsies on cases of icterus gravis. McIntosh

(1941) gave the incidence as not over 10 per cent., and Cappell (1947) also thought the incidence to be from 10 per cent. to 12 per cent. He believed that the damage to nerve cells must occur after birth, or certainly not long before birth, for in infants dying in the first few days the damaged tissue shows no sign of disintegration or removal. Hawksley *et al.* said that mental deficiency was the most important of the nervous sequelae of icterus gravis neonatorum.

Pasachoff (1935) described a case that was clinically erythroblastosis foetalis at the beginning of the illness, and then obstructive jaundice. The autopsy findings showed the presence of icterus gravis, kernicterus and complete atresia of the cystic, hepatic and common bile ducts. There was also cerebral aplasia. He stated that kernicterus did not occur in obstructive jaundice, but had been found almost exclusively as a rare accompaniment of icterus gravis neonatorum.

Zimmerman and Yannet (1935) discussed the possible pathogenic factors that might cause kernicterus to follow icterus gravis, and they reported in full the case of a child who had severe icterus during the first four weeks of life and who died aged three. The post-mortems were so strikingly similar to those seen in cases ending fatally from kernicterus during the first two weeks of life that the relationship could hardly be accidental.

The evidence produced by these workers is so conclusive that it seems well established that an infant surviving icterus gravis, even without developing definite signs of kernicterus during the period of generalized jaundice, may yet become a mental defective with signs and symptoms of involvement of the basal ganglia.

Fitzgerald, Greenfield and Kounine (1939) said they disagreed with Zimmerman *et al.* that kernicterus is solely associated with icterus gravis, and they cited Pasachoff (1935) as reporting a case of congenital atresia of the bile ducts with erythroblastosis and kernicterus. To the present writer this criticism is unwarranted, because, firstly, Zimmerman *et al.* (1933) stated that kernicterus was most frequently, if not exclusively, associated with icterus gravis, and in 1935 they reiterated that it occurred "almost" exclusively in association with that condition. Secondly, Pasachoff (1935) did not say that his case had congenital atresia of the bile ducts, but that it had complete atresia of the cystic, hepatic, and common bile ducts. Also, he stated categorically that kernicterus does not occur in obstructive jaundice. In addition, as has already been pointed out, Skelton and Tovey (1945) showed that certain cases of so-called "congenital" obliteration of the bile ducts were really sequelae of icterus gravis.

After severe jaundice has developed, Fitzgerald *et al.* said that symptoms referrable to involvement of the central nervous system manifest themselves within 24 hours. In this connection it has now been established as a result of the modern treatment of erythroblastosis foetalis with the early transfusion, repeated if necessary, of Rh-negative blood, that even this treatment, although it has a reasonable chance of saving the infant, does not prevent the onset of kernicterus. Clinically, according to Fitzgerald *et al.*, the children who survive kernicterus present a varied symptomatology, but in all the cases they described there was evidence of involvement of the extra-pyramidal system, such as choreo-athetoid movements and rigidity. Invariably, also, there was a marked degree of mental retardation, in many cases approaching the idiot class.

RH INCOMPATIBILITY AS A CAUSE OF MENTAL DEFICIENCY ASSOCIATED WITH KERNICTERUS.

It was thus definitely established, by the time the Rh factor was discovered in 1940, that mental deficiency was one of the sequels of kernicterus, which, in turn, occurred almost exclusively as a sequel of icterus gravis neonatorum, one of the forms that erythroblastosis foetalis might take. Hence, when it became established that the Rh factor was responsible for about 90 per cent. of all cases of that disease, it followed naturally that at least nine cases out of ten of mental deficiency associated with kernicterus were the ultimate result of Rh incompatibility. That the Rh factor can be responsible for mental deficiency in this way has now been generally accepted.

THEORY THAT RH INCOMPATIBILITY MAY CAUSE UNDIFFERENTIATED MENTAL DEFECT.

Yannet and Lieberman (1944) were the first to wonder if a more direct relationship between the Rh factor and mental deficiency could be established. They said that since the cerebral changes in kernicterus were most frequently described in cases of erythroblastosis foetalis, it appeared as a reasonable corollary that the pathogenesis of the cerebral pathology was in some way related to the mechanism of iso-immunization.

On the basis of present knowledge, they continued, the aetiological importance of iso-immunization in Rh-positive individuals with severe mental retardation, clinical evidence of basal ganglia involvement, a neonatal history suggesting erythroblastosis foetalis and an Rh-negative mother, would appear reasonably well established. However, if this specific syndrome were the only manifestation of iso-immunization, its importance in the overall picture of mental deficiency would be slight.

They stated, however, that there was some evidence which suggested the possibility that iso-immunization, as an aetiological factor, might possibly be involved in instances where central nervous system injury is not confined to the basal ganglia and where a characteristic history of erythroblastosis foetalis is not obtained. Two series of observations led to this idea. Firstly, in certain families where proved cases of kernicterus had occurred, as well as repeated pregnancies ending in erythroblastotic children, certain of the surviving infants presented clinical pictures in which evidence of basal ganglia involvement was not present. Instead, severe mental retardation either alone or associated with gross motor weakness, inco-ordination and convulsions, was present. Secondly, autopsies in some cases of neonatal deaths showed the presence of kernicterus, but the blood picture was not considered to be abnormal, and the jaundice was thought probably to be physiological.

The authors therefore came to the conclusion that it was reasonable to suggest the possibility that a certain proportion of the idiot and imbecile population, without an aetiologically significant clinical history or abnormality on physical examination, and now classified as "undifferentiated," might conceivably also represent the end result of iso-immunization during pregnancy.

RESULTS OF INVESTIGATION OF THE NEW THEORY.

They thereupon set out to investigate the incidence of Rh incompatibility in a series of low-grade institutionalized mental defectives. They examined altogether 109 defectives and their mothers. Of the defectives, 53 came into the category of recognized diagnostic groups (mongols, spastic diplegias, post-natal infective cases, birth traumas, cranial anomalies, etc.), and 56 were regarded as undifferentiated, cases where the cause of the deficiency could not be found. The former group were used as a control, and the findings were as follows: Control group, 6 mothers Rh-negative (11·3 per cent.). Of these mothers, 4 had an Rh-positive defective child, giving 7·5 per cent. as the incidence of Rh-incompatibility in the control group. In the undifferentiated group, however, 14 mothers were Rh-negative (25 per cent.), and of these, 11 had an Rh-positive defective child, giving 19·6 per cent. as the incidence of Rh incompatibility.

These figures show a striking difference, but Yannet *et al.* rightly admitted in their discussion that the simple demonstration of an Rh-negative mother of an Rh-positive child does not establish iso-immunization as the aetiological mechanism, but they pointed out that it does greatly limit the cases in which this possibility must be considered. They suggested that by concentrating on these children in the undiagnosed group, it might be possible eventually to establish the clinical syndrome in which the blood analysis would serve as a confirmatory finding.

In analyzing their results they pointed out that five cases of the incompatibility would be the result of random distribution, and that the remaining cases would represent 10 per cent. of the undifferentiated group studied. This would give an incidence of 3 to 4 per cent. for iso-immunization as an aetiological factor in institutionalized mental defectives, and this is about half the incidence of mongolism.

Commenting on these results, Cook (1944) agreed that they were striking, but rightly added the note of warning that the series was too small for definite conclusions to be drawn.

The work of Yannet *et al.* was soon checked by Snyder, Schonfield and Offerman (1945*a*). They examined 66 mothers, and their 68 mentally defective children. Of the 66 mothers, 17 were Rh-negative, nearly twice the expected frequency. Of the 68 defective children, 11 were Rh-positive from Rh-negative mothers, and this is more than double the expected frequency.

Snyder *et al.* (1945*b*) added some further figures to their previous total. They examined another 47 cases, but they found that the very high incidence of Rh-negative mothers and of Rh-positive children from these mothers was not maintained, and was only slightly higher than expectation. Their combined results, however, from 113 mothers and 115 mentally defective children, were still in excess of those expected, although only significantly so instead of highly significantly so.

Yannet and Lieberman (1946), however, followed up their original series with another larger one. They examined 277 defectives all with an I.Q. of less than 30. Of these, 158 fell into the well-defined categories, and the remaining 119 were regarded as being undifferentiated. In the control group, 22 (14 per cent.) of the mothers were Rh-negative and 12 of these had an Rh-positive child, giving a 7·6 per cent. incidence of Rh incompatibility. Among the undifferentiated cases, however, 26 (22 per cent.) of the mothers were Rh-negative and 19 of these had an Rh-positive child, giving an incidence of 16 per cent. for Rh incompatibility in this group. The difference between the two ratios (7·6 per cent. and 16 per cent.) was stated to be statistically significant.

In this article, Yannet *et al.* discussed possible theories as to the mechanism whereby mental deficiency could result from iso-immunization of the mother by the foetus. The suggested theories were (1) the possibility of irreversible cellular injury due to an antibody-antigen reaction ; (2) cerebral injury entirely secondary to the destruction of red blood cells during foetal life, this being really an anoxaemia ; and (3) the possibility that the products of extensive red cell destruction *per se* may be injurious to the developing neurone.

Criticisms of the New Theory.

Yannet *et al.'s* theory has been criticized by Scholl, Wheeler and Snyder (1947) and by Cappell (1947). The former writers stated that the final acceptance of the theory of a positive relationship between Rh immunization and feeble-mindedness would require immunological confirmation and a systematic experiment on a larger scale than hitherto carried out. For such an experiment to be conclusive they maintained it should include the following factors :

(1) Case material should include a much larger number of patients, preferably more than 25 Rh-positive children from Rh-negative mothers.

(2) The immunological studies should be performed as soon as the child is found to be mentally deficient, preferably within a year following delivery.

(3) Subsequent children in the families should be studied for evidence of erythroblastosis at birth, thus causing a postponement of the publication of the study for a number of years.

(4) Criteria for the classification of the defect should be stated.

(5) Data on the occurrence of other neurological disorders such as athetosis, convulsions and spasticity, which are known to accompany kernicterus, should be stated.

These authors then gave the results of a careful restudy of the cases reported by Snyder *et al.* (1945*a* and *b*). They concluded that this restudy offered no support to the theory of Yannet *et al.*, but they admitted that it did not disprove it. They also admitted that the data on which the relationship was originally postulated were statistically significant.

Cappell (1947) was much more severe in his criticism. He agreed it was known that icteric staining of the brain may sometimes take the form of a diffuse colouration of the cortex in greater or less degree, either alone or along with basal nuclear staining, and he admitted that it may be accepted without hesitation that mental deficiency may follow consequently upon icterus gravis, even in the absence of clinical signs of kernicterus. He said that Yannet *et al.'s* figures were unsound, however, for they included in the undifferentiated group six cases of undoubted icterus gravis and kernicterus. If these were placed in the specific group, then the difference in the incidence of Rh-negative mothers between the two groups disappears. In a series of 200 cases of defective children, examined from his department, Cappell found no significant increase in the incidence of Rh incompatibility, and he concluded that it seemed improbable that Rh incompatibility could cause mental deficiency in the absence of overt haemolytic disease in the neonatal period.

Object and Method of Present Investigation.

The aim of the present study has been to test Yannet *et al.'s* theory under as stringent conditions as possible, and to see whether any definite conclusions can be drawn as to its truth or otherwise. The investigation, however, has been widened to include feeble-minded cases and those living at home under guardianship or supervision, because it was felt, as suggested in a *British Medical Journal* editorial comment (August 10, 1946), that if there were any truth in the theory, the figures in feeble-minded cases should be even more striking than they were in the low-grade defectives.

The method adopted was the simplest that could be devised in the circumstances. The case records of all the defectives on the books of the local authorities concerned were examined, and those whose mothers were still alive were picked out. These mothers were invited to co-operate, and although by no means all of them did so, I was able to examine 427 cases altogether. They were quite a random selection, and there was no picking or choosing of cases. In fact, at this early stage of the investigation I deliberately kept myself in ignorance of the degree and type of defect present in the offspring of the mother from whom I was taking the blood.

As complete histories as possible were obtained in every case, irrespective of whether the mother proved to be Rh-negative or not, and no assumptions, for example, were made as to the effect of a bad fall in early childhood without special enquiries regarding all the circumstances at the time. This was all the more necessary as it was found that parents were prone to blame the slightest extraneous factor as being the cause of their child's mental defect.

A special history form was prepared setting forth all the points on which information was wanted, as it was found that the case records, quite understandably, were incomplete from the point of view of this investigation. When all the facts available in each case were obtained, it was finally decided into which category each defective was to be placed. At this stage, the records of the Rh investigation were kept separate, so that when each defective was classified it was not known whether Rh incompatibility was present or not. The aim was to be left with a residue of cases quite undifferentiated in type (including some epileptics where there was no other factor operating which might be the cause of both the defect and the epilepsy, e.g. meningitis, or birth injuries) and where it was impossible to obtain evidence of any adequate cause of the defect. It should be noted that in the type of case where another possible cause was present, but reasonable doubt existed as to its actual responsibility in producing the defect, such a case was included in the undifferentiated group.

Further, a fair proportion of the defectives examined had reached adult life, so that in a few instances the mother was unable to remember details of the birth and first few weeks of life of the defective in question. In all such cases where the history was incomplete and the defective was not a mongol or one of the other recognized types, he or she was placed in the undifferentiated group. As a rule, however, there was little difficulty in classifying the defective, and it was not considered that this factor would influence the results to any significant degree.

Requiring special mention were those cases of otherwise undifferentiated mental defect where the family history was such that the factor of heredity had to be taken into account as a possible cause of the deficiency. At first I was definitely of the opinion that these cases should be classed along with the specific group, as a factor at least in the causation of the deficiency was reasonably well established. On thinking the matter over further, however, I was compelled to admit that these cases did not belong to any specific type of mental defect, and I felt then that they should be classed with the undifferentiated group. I was still not satisfied, however, because now the undifferentiated group would not fulfil all the conditions laid down for it.

In order to obtain comparable figures with those of the American workers, I had decided to use the specific group of defectives as a control against the undifferentiated group, so now, in order to get over the difficulty noted above, I decided to do two complete series of calculations, the first with the " heredity " cases in the control group, and the second with these cases in the undifferentiated group, and to compare the results to see if any significant difference was made to the test (undifferentiated) group. The idea was conceived that, since the Rh factor is inherited on Mendelian lines, and since it has been suggested that the tendency for an Rh-negative woman to become immunized against the Rh antigen is also inherited, possibly Rh incompatibility might be a factor in the inheritance of otherwise undifferentiated mental defect. I realized that a comparison between the two series of results might at least show whether this theory was worth pursuing or not.

The specific, or control, group, excluding the " heredity " cases, consisted of 152 cases divided as follows: mongols 56, organic nervous disease (excluding spastics) 29, spastics 26, microcephalics 11, birth and early childhood injuries 8, hydrocephalics 7, endocrine disorders (excluding cretins) 5, cretins 4, congenital G.P.I. 2, kernicterus and icterus gravis 4.

I have put the kernicterus and icterus gravis cases into the control group, and not the undifferentiated group as did the Americans, for in my opinion Cappell's criticism is justified that this is an investigation into the possibility of Rh incompatibility being a cause of undifferentiated mental defect without associated evidence of kernicterus or a history of erythroblastosis foetalis. These were the conditions laid down by Yannet and Lieberman themselves in their original article and therefore they ought to be adhered to strictly.

RESULTS OF INVESTIGATION.

The total number of cases investigated was 427 inclusive of control and test cases, and the results for the whole series are shown in Table I.

TABLE I.

Total number of cases investigated	427
,, ,, of Rh-negative mothers	84 = 19·7%
Number of Rh-negative mothers with Rh-positive children	52 = 12·2%

Tables II and III show the results for the control group.

TABLE II.—*Control Group (including "Heredity" Cases).*

Number of cases investigated	177
,, Rh-negative mothers	42 = 23·7% (S)
,, Rh-negative mothers with Rh-positive children	23 = 13·0%

S = significant.

TABLE III.—*Control Group (excluding "Heredity" Cases).*

Number of cases investigated	152
,, Rh-negative mothers	35 = 23·0% (S)
,, Rh-negative mothers with Rh-positive children	20 = 13·2%

S = significant.

Tables IV to IX show the results for the test group. I divided this group into two classes, (1) the feeble-minded, or high-grade cases of mental defect, and (2) the imbeciles and idiots, or low-grade cases of mental defect. The results are given for the whole group and then for the two classes within the group.

TABLE IV.—*Whole Test Group (excluding "Heredity" Cases).*

Number of cases investigated	250
,, Rh-negative mothers	42 = 16·8%
,, Rh-negative mothers with Rh-positive children	29 = 11·6%

TABLE V.—*Whole Test Group (including "Heredity" Cases).*

Number of cases investigated	275
,, Rh-negative mothers	49 = 17·8%
,, Rh-negative mothers with Rh-positive children	32 = 11·6%

TABLE VI.—*Feeble-minded Cases (excluding "Heredity" Cases).*

Number of cases investigated	113
,, Rh-negative mothers	21 = 18·6%
,, Rh-negative mothers with Rh-positive children	16 = 13·3%

TABLE VII.—*Feeble-minded Cases (including "Heredity" Cases).*

Number of cases investigated	122
Number of Rh-negative mothers	24 = 19·7%
,, Rh-negative mothers with Rh-positive children	17 = 13·9%

TABLE VIII.—*Imbecile and Idiot Cases (excluding "Heredity" Cases).*

Number of cases investigated	137
Number of Rh-negative mothers	21 = 15·3%
,, Rh-negative mothers with Rh-positive children	14 = 10·2%

TABLE IX.—*Imbecile and Idiot Cases (including "Heredity" Cases).*

Number of cases investigated	153
,, Rh-negative mothers	25 = 16·3%
,, Rh-negative mothers with Rh-positive children	15 = 9·8%

For the purposes of comparison, all the above results have been summarized in Table X (percentages only).

TABLE X.

	Percentage Rh-negative mothers.		Percentage Rh-negative mothers with Rh-positive children.	
	Excluding "heredity" cases.	Including "heredity" cases.	Excluding "heredity" cases.	Including "heredity" cases.
Control group	23·0% (S)	23·7% (S)	13·2%	13·0%
Whole test group	16·8%	17·8%	11·6%	11·6%
Feeble-minded cases	18·6%	19·7%	13·3%	13·9%
Imbecile and idiot cases	15·3%	16·3%	10·2%	9·8%

ANALYSIS OF RESULTS AND CASE MATERIAL.

Owing to the limited time at my disposal it has not been possible to examine a series of normal children and their mothers to get normal control figures, and it is therefore necessary to define exactly the basis which has been taken for comparing the above results with the normal average figures for the general population.

Race, Mourant, Lawler and Sanger (1948) gave the observed and the expected genotype frequencies in 2,000 cases. The expected frequencies (based on the chromosome frequencies calculated by Professor Fisher) and the observed frequencies agreed closely, and I have therefore taken as the normal standard the expected frequencies as given by Race *et al.*

The frequency of the genotype rr (cde/cde) is expected to be 15·10 per cent. If to this figure are added the expected frequencies of the genotypes made up from combinations of r′, r″, and r, the expected frequency of all genotypes lacking the antigen D is 16·84 per cent. This figure agrees closely with the observed figure of 17·07 per cent. for all subtypes of Rh-negative cases, as given by Race *et al.*, and it is therefore being taken as the normal standard in the present investigation. The expected frequency of Rh-positive children from Rh-negative mothers can be calculated from the gene frequencies given by Race *et al.*, and it is 9·92 per cent. This figure agrees very closely with the one of 10 per cent. mentioned by Cappell (1946), and it has been adopted as the normal standard in this study.

(a) *Whole Group of Mental Defectives.*

It will be seen from Table I that out of a total of 427 mothers of mental defectives of all types and grades, 84, or 19·7 per cent. were Rh-negative, while 52, or 12·2 per cent. of these mothers had an Rh-positive defective child. Neither of these figures is statistically significant, so that the mental defective population as a whole does not appear to differ materially from the normal population.

(b) *"Control" Group of Mental Defectives.*

Tables II and III, giving figures for the control group, should be taken together as they show the difference in the figures when the "heredity" cases are included and excluded respectively. Out of 177 cases there were 42, or 23·7 per cent. Rh-negative mothers, and of these 23, or 13·0 per cent., had an Rh-positive defective child; whereas out of 152 cases there were 35, or 23·0 per cent., Rh-negative mothers, and of these 20, or 13·2 per cent., had an Rh-positive defective child. It will be seen that the inclusion or exclusion of the "heredity" cases gives almost identical percentages in the control group. The figures of 23·7 per cent. Rh-negative mothers in 177 cases, and 23·0 per cent. Rh-negative mothers in 152 cases are both statistically significant.

In Table XI the control group (excluding "heredity" cases) is further analysed. It will be observed that in the first two main groups, the mongols and cases of organic nervous disease, the figures in columns 2 and 3 are quite within normal limits, but in the third group, the spastics, there is a high proportion of cases both in columns 2 and 3.

In Appendix A (Cases 1–20) are described the clinical histories of the control cases in which Rh incompatibility has occurred, and of these the six cases amongst the spastics are Nos. 7–12. The very high incidence of incompatibility, even in this small series of 26 cases, could lead to the supposition that possibly it has something to do with the condition, but in Cases 7–11 there was no history suggestive of erythroblastosis, and no atypical agglutinins were found in the mothers' sera. Case 9 had meningitis at the age of 6 months, and this may have caused the paralysis. Case 11 showed tremor and inco-ordination of all movements, but no true athetosis was present. Case 12 did have a history of neonatal jaundice which lasted intermittently for three months and paralysis involving the right side subsequently developed. There was no athetosis, and the family history did not definitely suggest that iso-immunization had occurred, so I did not class this case as one of icterus gravis, although it may possibly have been.

TABLE XI.

	1 Total cases.	2 Total Rh—ve mothers.	3 Rh—ve mothers with Rh+ve children.
Mongols	56	7	3
Organic nervous disease	29	4	3
Spastics	26	8	6
Microcephalics	11	4	2
Birth and early childhood injuries	8	2	-
Hydrocephalics	7	3	-
Endocrine disorders	5	2	2
Cretins	4	1	–
Congenital G.P.I.	2	–	–
Kernicterus and icterus gravis	4	4	4
Total	152	35	20

The histories of both the microcephalics in which Rh incompatibility occurred (Nos. 13 and 14) in each case suggested that the mother was in fact immunized, although not necessarily by the defective in question. In neither case were atypical agglutinins found in the mother's serum, nor was there any history of jaundice. In both cases the family history was rather typical of iso-immunization, and in Case 14 the child was very anaemic when born. I did not feel justified, however, in classifying either of these cases as erythroblastosis foetalis.

There were four definite cases of erythroblastosis foetalis (Nos. 17–20), and in three of these (Nos. 18, 19, 20) there was no doubt whatever of the presence of kernicterus. In all four cases there was a history of neonatal jaundice and the family histories were typical of iso-immunization having occurred. Case 20 is particularly interesting: the defective, aged 15, was the youngest in the family and there were no subsequent pregnancies, yet strong antibodies were found in the mother's serum, and these agglutinated Rh-positive cells. For such strong antibodies to persist for 15 years must be comparatively rare.

Erythroblastosis foetalis is expected to occur in the general population in 1 : 200 to 1 : 250 births. Further, of the cases surviving erythroblastosis, not more than 10 per cent. may be expected to show the clinical signs of kernicterus. This means that in the general population kernicterus occurs in not more than 1 : 2,000 cases. In my total number of 427 cases, therefore, it would not have been surprising if no cases of kernicterus had been found, were it not for the fact that this disease is a definitely recognized cause of mental deficiency. It is reasonable to assume, therefore, that on testing a sample of mental defectives one would expect to find a slightly higher incidence of Rh incompatibility than in the general population, due to this concentration of kernicterus cases.

As has been shown, the percentage of negative mothers and of negative mothers with positive children in the total sample is not significantly high; but in the control group, which has concentrated still more the cases of kernicterus, the incidence, both of negative mothers and of those with positive children, is higher than in the total sample, although only in the first case is the figure significant.

The control group was therefore recalculated, the three cases of kernicterus being omitted. It would then read as in Table XII.

Table XII.—*Control Group (excluding Kernicterus Cases).*

	Including "heredity" cases.	Excluding "heredity" cases.
Number of cases investigated .	174	149
,, Rh-negative mothers .	39 = 22·4%	32 = 21·5%
Rh-negative mothers with Rh-positive children . . .	20 = 11·5%	17 = 11·4%

The figures for the incidence of Rh-negative mothers are now brought below the level of statistical significance, and the figures for the incidence of Rh incompatibility are proportionately reduced practically to the normal average for the general population.

(c) *Test Group of Undifferentiated Mental Defectives.*

Table IV shows that there were 250 cases of all grades of defect, excluding the "heredity" cases. Of these, 42 mothers (16·8 per cent.) were Rh-negative, while 29 of these mothers (11·6 per cent.) had an Rh-positive defective child. Neither of these figures differs materially from the normal standards. When the "heredity" cases are added (Table V), it will be seen that out of 275 cases, 49 (17·8 per cent.) mothers were Rh-negative, and of these, 32 (11·6 per cent.) had Rh-positive defective children. Again neither figure is significant.

Table XIII shows how the "heredity" cases were divided.

Table XIII.—"*Heredity*" *Cases.*

	Total cases.	Total Rh-negative mothers.	Rh-negative mothers with Rh-positive children.
Feeble-minded . .	9	3	2
Imbeciles and idiots .	16	4	1
Total . .	25	7	3

When the test group is divided into feeble-minded cases (high-grade defect) and imbecile and idiot cases (low-grade defect), the results are equally interesting if only for their normality.

Table VI shows the feeble-minded cases, excluding the feeble-minded "heredity" cases. Out of 113 cases, 21 (18·6 per cent.) mothers were Rh-negative, and of these, 15 (13·3 per cent.) had Rh-positive defective children. These figures are not significant. Even when the "heredity" cases are added (Table VII), out of a total of 122 cases, 24 (19·7 per cent.) mothers were Rh-negative, while of these, 17 (13·9 per cent.) had Rh-positive defective children. Although these figures are slightly higher than those in Table VI, they are still not statistically significant.

The figures for the low-grade group are even more striking. From Table VIII, "heredity" cases excluded, it is seen that out of 137 cases, 21 (15·3 per cent.) mothers were Rh-negative, and of these, 14 (10·2 per cent.) had Rh-positive defective children. Addition of the "heredity" cases (Table IX) shows that out of 153 cases, 25 (16·3 per cent.) mothers were Rh-negative, and of these, 15 (9·8 per cent.) had Rh-positive defective children. These figures could scarcely be more normal.

The clinical histories of the cases of undifferentiated defect in which Rh incompatibility occurred are described in Appendix B (Cases 21 to 52).

Case 24 showed slight jaundice immediately after birth and its duration was unknown, but there was nothing else in the history to suggest erythroblastosis, and the jaundice was regarded as physiological and nothing more.

Case 25 was thought to have had a head injury when she fell downstairs at the age of four, but there was no evidence that this had any bearing on the mental defect, and there was nothing else in the history to suggest this was not an undifferentiated case.

Case 26 did have slight jaundice just after birth, but, in view of his position in the family (8th out of ten pregnancies), and the family history of the second and third pregnancies having ended in stillbirths, followed by four siblings alive and well, then the defective, and finally two more siblings alive and well, it is reasonable to suppose that if the stillbirths had been due to iso-immunization the effect on the defective would have been much more serious. The jaundice was therefore regarded as physiological.

In Case 30 the mother had a bad fall during the early stages of the pregnancy, but she carried on successfully to term with no threat of a miscarriage at the time of the fall, so that it is very unlikely it had anything to do with the defect in the child.

The family history in Case 32 rather suggested that iso-immunization had occurred, although no atypical agglutinins were found in the mother's serum. In the defective's history, however, there was no evidence of erythroblastosis, and so he was classed as undifferentiated.

Case 35 is especially interesting. There were ten pregnancies of which he was the first, so that it would not be expected that iso-immunization would occur in his case. Atypical agglutinins were found in the mother's serum, however, proving that she was sensitive and had been immunized, but there was no evidence that the defective had been affected.

Case 45: The early history of this defective and the family history suggested that syphilis was the cause of the stillbirths and miscarriages. In view of the fact, however, that no confirmation could be obtained from the hospital where the defective was supposed to have been treated, and that she now shows no stigmata of syphilis, she has been classified as undifferentiated.

Case 46: The family history in this case strongly suggested that iso-immunization had occurred in the mother, although no confirmation could be obtained. As there was no history of erythroblastosis in the defective (2nd pregnancy), however, he has been classed as undifferentiated.

The rest of the cases described in Appendix B are all quite straightforward and require no further comment.

(d) *Homospecific and Heterospecific Pregnancies.*

It was noted earlier in this study that some evidence had been produced showing that iso-immunization to the Rh factor was favoured by a homospecific pregnancy rather than a heterospecific one. In a series of pregnancies where iso-immunization had been proved to have occurred the proportion of homospecific pregnancies was unduly high, and there was also an undue number of Group A bloods amongst the Rh-negative mothers. In Table XIV is listed the distribution of the ABO groups amongst the mothers and defectives in the 52 cases where Rh incompatibility occurred. It will be seen that this distribution is quite within normal limits, both amongst the mothers and the defectives.

Normally, a heterospecific pregnancy may be expected to occur in about 20 per cent. of cases. Table XV shows the proportion in the present series of cases of Rh incompatibility. In the whole group, the control group, and the test group (all cases) the frequency of the homospecific pregnancies as compared with the heterospecific ones could scarcely be more normal, and in the sub-divisions of the test group the numbers are so small that the slight variation is not significant.

Table XIV.

	Mothers.	Defectives.
Group O	24	27
Group A	23	21
Group B	2	1
Group AB	3	3
Total	52	52

Table XV.

	Total pregnancies.	Homospecific pregnancies.	Heterospecific pregnancies.
Whole group	52	41	11
Control group	20	16	4
Test group (all cases)	32	25	7
Feeble-minded cases	17	15	2
Imbecile and idiot cases	15	10	5

DISCUSSION.

Since Rh incompatibility occurs in practically 10 per cent. of pregnancies, the theory that such an incompatibility might be a factor in the genesis of otherwise undifferentiated mental defect of unknown origin is a very important and attractive one, because of the profound and far-reaching implications involved. Yannet and Lieberman's figures, although on small numbers of cases, particularly in their first series, appeared to support this theory, but it was obvious that further confirmatory evidence would be necessary before such a theory could be accepted and acted upon. In the present work the conditions laid down by these writers have been adhered to as strictly as possible, so that my results would bear an exact comparison, and any conclusions drawn could not be criticized on the grounds of a difference in these conditions. One difference, a fundamental one, has emerged, however, and it is the conception of what is the normal incidence of Rh-negative individuals and of Rh incompatibility. This point will be discussed more fully presently.

The principles laid down by Scholl, Wheeler and Snyder (1947) that should be observed in the conduct of an investigation such as this have already been quoted, and it must be admitted that it has not been possible to fulfil them all in the present study. The number of cases of undifferentiated defect showing Rh incompatibility is 32, thus exceeding the 25 stipulated by Scholl *et al.* as a minimum. It has not been possible to examine any case within a year of birth, but an appreciable number were quite young children although many of the cases had reached adult life. The family histories were studied in each case, and any suggestion of erythroblastosis in other siblings was noted. All the cases examined had been certified under the M.D. Acts of this country, and earlier on in this work I have stated how it was finally decided which cases were truly undifferentiated. Finally, in the clinical histories given in the Appendices, any neurological abnormalities found to be present have been noted.

A comparison between Yannet *et al.'s* figures and those in the present work is both interesting and instructive. If their two series of cases are added together, they examined a total of 386 cases, 41 fewer than in this series. Table XVI shows the results of the two total series.

TABLE XVI.

	Total cases.	1 Total Rh-negative mothers.	2 Rh-negative mothers with Rh-positive children.
Yannet and Lieberman	386	68 (17·6%)	46 (11·9%)
Gilmour	427	84 (19·7%)	52 (12·2%)

Table XVII compares the results when the two groups are divided into "control" and "undifferentiated." For this purpose I have included the "heredity" cases of my series in the undifferentiated group.

TABLE XVII.

	Total cases.	Total Rh-negative mothers.	Rh-negative mothers with Rh-positive children.
Yannet and Lieberman control cases	211	28 (13·2%)	16 (7·6%)
Gilmour control cases	152	35 (23·0%)	20 (13·2%)
Yannet and Lieberman undifferentiated cases	175	40 (22·9%)	30 (17·1%)
Gilmour undifferentiated cases	275	49 (17·8%)	32 (11·6%)

It is seen from Table XVI that my percentages are very slightly higher in both columns 1 and 2 than those of the Americans, and it is also seen that there is no statistical significance in the American figures for their total series of cases. From Table XVII the difference in the two sets of figures, both as regards total cases and the percentages, is at once apparent.

One reason for at least part of the difference in proportion between the control numbers and the undifferentiated numbers in the American series and mine is that I widened the scope of the investigation to include feeble-minded cases. Amongst my controls the big majority were low-grade (3·34 : 1), whereas amongst the undifferentiated the numbers were more nearly equal (1·25 : 1). The main reason for the marked difference in the percentages is undoubtedly that mentioned by Cappell (1947) and which has already been discussed, namely, the inclusion of the kernicterus and erythroblastosis cases by Yannet *et al.* in the test group and by me in the control group.

Another point, already hinted at, to be discussed in this comparison between the two sets of figures is the question of what are the normal figures with which to compare those in the test groups of cases. On this point there appears to be some difference of opinion between workers in America and in this country. Snyder *et al.* (1945*a*) stated unequivocally that in the general population 87 per cent. are Rh-positive and 13 per cent. Rh-negative; while Rh incompatibility occurs in about 8 per cent. of pregnancies. They obtained this figure of 13 per cent. for the incidence of Rh-negative people by regarding as negative only those who are completely so (cde/cde). Cook (1944), in the *Journal of Heredity*, said that conceptions in Rh-negative women will average 60 per cent. incompatible. If this figure is applied to the 13 per cent., the percentage of Rh-positive children from Rh-negative mothers certainly works out at about 8 per cent. (actually 7·8 per cent.).

It has already been discussed, however, why this conception of what should be regarded as Rh-negative is not correct when applied to incompatible pregnancies. If the figure of 15 per cent. for the incidence of Rh-negative individuals is taken as the normal, the expected percentage of incompatible pregnancies then becomes exactly 9 per cent. on Cook's formula. Race *et al.* (1948), however, have clearly shown that the percentage of completely negative individuals, rhrh (cde/cde), is in fact 15 per cent., and that when to these are added the other Rh-negative groups r′ and r″ the figure for all Rh-negative individuals is then 16·84 per cent. Cook's formula applied to this gives the expected proportion of incompatible pregnancies as 10·1 per cent. The figure on which the present results have been statistically assessed is actually a shade lower, however, (9·92 per cent.), as this figure was calculated from the gene frequencies of the elementary antigens as given in the paper by Race *et al.*

Some trouble has been taken to emphasize this point, because if the present figures had been assessed on the American percentages, some of them, apart from the total number of Rh-negative mothers in the control group (see Tables II and III) would have been just statistically significant.

Finally, it should be observed that the percentages for my test group of imbeciles and idiots, the group comparable to Yannet and Lieberman's test group, could scarcely be more normal. In my series there were 153 cases (including the "heredity" ones) against the Americans' 175, and the respective percentages were 16·3 per cent. against 22·9 per cent., and 9·8 per cent. against 17·1 per cent.

Homospecific and Heterospecific Pregnancies.

The distribution of the ABO groups and the proportion of homospecific to heterospecific pregnancies were calculated because of observations made about their effect on iso-immunization, in relation to the Rh antigen. It was felt that although the total numbers were small, an observation on these points might at least produce confirmatory evidence one way or the other. This has, in fact, been the case, since both the distribution of the ABO groups and the ratio of homospecific to heretospecific pregnancies are within normal limits. They therefore suggest that iso-immunization in the cases of proved Rh incompatibility would not occur more often than normal. This is consistent with the actual findings in the present study, when allowance is made for the rather high incidence of cases of kernicterus. This increased incidence was to be expected, as has already been shown, and in all three cases of kernicterus the pregnancies were homospecific.

Effect of "Heredity" Cases.

Although throughout this work the 25 cases in which mental defect was found in the family history, apart from the defectives under consideration, have been referred to as "heredity" cases, it has not been meant to imply thereby that these cases were thought to be due solely to a bad heredity. What has been felt is that in these cases the hereditary factor must at least be taken into account. It will be seen from a study of Table X, where all the percentages have been summarized, that the inclusion or exclusion of these "heredity" cases makes virtually no difference to the figures, and there is no evidence to suggest that the Rh factor plays any part in the hereditary transmission of mental deficiency.

CONCLUSION.

The following points have been established as a result of the present work:

Compared with the percentage for the general population of this country, there was no significant difference in the percentage number of cases of Rh incompatibility either in the whole group of defectives, in the control group, or in the test group, either in its entirety or when subdivided into high grade and low-grade cases.

Similarly, there was no significant difference between the figures for the control group and the test group.

Further, in the cases in which Rh incompatibility occurred, the ordinary blood group distribution and the proportion of homospecific and heterospecific pregnancies were quite normal.

From a careful consideration of the above points and of all the factors detailed in this work, I have come definitely to the conclusion that, so far as my results are concerned, the sample of cases from which they were obtained could equally well have been taken from the general population instead of a mental defective one. For this reason it is my opinion that Rh incompatibility, apart from when it causes erythroblastosis foetalis and kernicterus, plays no part in the aetiology of mental deficiency.

SUMMARY.

The literature on the Rh factor and its relationship to human disease, physical and mental, has been reviewed.

My own investigation into the incidence of Rh incompatibility in 427 cases of mental deficiency has been described.

The conclusion has been drawn that Rh incompatibility, *per se*, is not a factor in the causation of mental deficiency.

APPENDIX A.

Control Group of Cases showing Rh Incompatibility.

Note.—Unless otherwise stated, there was no history in the defective of erythroblastosis foetalis, nor were atypical agglutinins found in the mother's serum.

1. *Mongols.*

CASE 1.—R. C—, aet. 12. Third of three pregnancies. Homospecific. Mother's group, A Rh −ve; Defective's group, A Rh +ve.

Pregnancy and confinement were normal. Defective was always delicate, and is a typical mongol.

Family history: Eldest sibling is alive and well. Second pregnancy ended in a stillbirth, but details not known. Father's sister had a mental breakdown.

CASE 2.—D. J. O—, aet. 4. First of two pregnancies. Heterospecific. Mother's group, A Rh −ve; defective's group, AB Rh +ve.

Pregnancy was normal, but child was premature, although otherwise normal. Defective is a typical mongol.

Family history: Younger sib. is a. and w. Otherwise *nil.*

CASE 3.—M. W—, aet. 11. Sixth of six pregnancies. Homospecific Mother's group, B Rh −ve; defective's, O Rh +ve.

Pregnancy and confinement normal. Defective a typical mongol.

Family history: The three eldest sibs. are a. and w. They were followed by two miscarriages and then the defective. Cause of miscarriages not known. Otherwise *nil.*

2. *Organic nervous disease.*

Case 4.—D. T. C—, aet. 4. Second of three pregnancies. Heterospecific. Mother's group, O Rh−ve; defective's, A Rh+ve. Defective is a twin.

Pregnancy normal, but defective and twin were three weeks premature. An instrumental delivery. Defective a very small child who has never developed properly. Has optic atrophy and is practically blind. There is rigidity of all muscles which go into spasm. Mentally he is very backward, being an imbecile.

Family history: First pregnancy, twins, premature. Both died 36 hours after birth. Defective's twin is a. and w., and youngest child is a. and w. Otherwise *nil.*

Case 5.—J. N. S—, aet. 24. Third of six pregnancies. Homospecific. Mother's group, A Rh−ve; defective's, O Rh+ve.

Pregnancy normal, prolonged labour, and child had convulsions at birth. Meningitis at two weeks, resulting in paralysis of the left side. Operation to eye at three months. Pneumonia at one year and three months. He is a feeble-minded epileptic.

Family history: First pregnancy ended in miscarriage, second in stillbirth. Fourth child died of pneumonia at three months; the fifth child died of T.B. Sixth is a. and w. No history of jaundice in the other children. Mother said to have had " brain fever " when she was born.

Case 6.—L. L. E—, aet. 28. Fifth of seven pregnancies. Homospecific. Mother's group, O Rh−ve; defective's, O Rh+ve.

Pregnancy and confinement normal. Defective developed encephalitis lethargica when a few years old, since when she has never been right. She is feeble-minded.

Family history: Eldest three sibs. a. and w. Fourth died at three years of measles. Sixth and seventh sibs. a. and w. Otherwise *nil.*

3. *Spastics.*

Case 7.—N. D. F—, aet. 20. Fourth of four pregnancies. Homospecific. Mother's group, B Rh−ve; defective's, O Rh+ve.

Pregnancy and confinement normal, although he was one month premature. Spasticity noticed when he did not begin to walk. Now walks with difficulty, and cannot go far from home.

Family history: Eldest sib. a. and w., second died at 16 months of measles. Third a. and w. Otherwise *nil.*

Case 8.—R. F—, aet. 31. Seventh of eight pregnancies. Homospecific. Mother's group, A Rh−ve; defective's, A Rh+ve.

Pregnancy and confinement normal as far as known. Defective paralyzed from birth, and is bedridden and helpless.

Family history: Eldest five sibs. a. and w. Sixth died at one year, cause unknown. Eighth a. and w. Otherwise *nil.*

Case 9.—R. E. A—, aet. 23. Third of seven pregnancies. Heterospecific. Mother's group, O Rh−ve; defective's, A Rh+ve.

Pregnancy and confinement normal. Defective had meningitis at six months, and suffers from spastic paralysis.

Family history: Eldest sib. a. and w. Second died at 18 months, thought to be due to food poisoning. Fourth died at two days, cause unknown. Fifth and sixth a. and w. Seventh a miscarriage at three months. Otherwise *nil.*

Case 10.—J. W., aet. 10. Second of two pregnancies. Homospecific. Mother's group, A Rh−ve; defective's, A Rh+ve.

Pregnancy and confinement normal. Spasticity first observed when defective due to start walking. Shows inco-ordination of hands, but no true athetosis.

Family history: Elder sib. died at 14 months of bronchitis. Mother and maternal aunt are epileptics.

CASE 11.—J. A. W—, aet. 11. Only pregnancy. Homospecific. Mother's group, A Rh −ve; defective's, O Rh +ve.

Pregnancy normal. Breech birth, six weeks overdue it is stated by mother. Defective a spastic, and all movements show tremor and inco-ordination.

Family history: *Nil.*

CASE 12.—B. J. R—, aet. 17. Fourth of four pregnancies. Homospecific. Mother's group, AB Rh −ve; defective's, A Rh +ve.

Pregnancy and confinement normal. Child apparently normal at birth, but at three days developed jaundice which lasted intermittently for about three months. A few months later, paralysis of right side developed, and defective can walk only a little with support. Defective is also an epileptic, fits having occurred since the age of ten.

Family history: Eldest two sibs. a. and w. Third pregnancy ended in miscarriage at three months. Otherwise *nil.*

4. *Microcephalics.*

CASE 13.—J. H. W—, aet. 35. Second of 14 pregnancies. Homospecific. Mother's group, O Rh −ve; defective's, O Rh +ve.

Pregnancy normal, but birth premature, 6½ months. Defective very delicate and blind for six months.

Family history: Eldest sib. died aet. 24, of nephritis. Third a. and w.; fourth died at 14 months, paralysed. Pregnancies 5 to 9 all ended in stillbirths. Tenth sib. died within a few hours. Pregnancy eleven ended in stillbirth. Pregnancies 12 and 13 ended in miscarriages. Fourteenth sib. a. and w. Both grandmothers are believed to have been epileptics.

CASE 14.—M. M. S—, aet. 17. Fourth of five pregnancies. Homospecific. Mother's group, A Rh −ve; defective's, O Rh +ve.

Pregnancy normal. Extended breech birth. Child very anaemic when born and had no finger- or toenails. No jaundice.

Family history: Eldest two sibs. a. and w. Third pregnancy ended in miscarriage. Fifth sib. a. and w. Otherwise *nil.*

5. *Endocrine disorders.*

CASE 15.—F. B—, aet. 20. Third of seven pregnancies. Heterospecific. Mother's group, A Rh −ve; defective's, AB Rh +ve.

Pregnancy and confinement normal. Defective did not develop normally physically owing to endocrine imbalance for which he was treated in hospital.

Family history: First sib. died at nine months of meningitis. Second and fourth a. and w. Fifth died at ten months of mastoid trouble. Sixth and seventh (illegitimate) a. and w. Mother not very bright intellectually.

CASE 16.—J. W. J—, aet. 24. First of two pregnancies. Homospecific. Mother's group, O Rh −ve; defective's, O Rh +ve.

Pregnancy and birth normal. This individual is a moral rather than an intellectual defective. He is a dwarf, and has been in trouble many times for slitting girls' mackintoshes.

Family history: Younger sib. a. and w. Otherwise *nil.*

6. *Erythroblastosis foetalis and kernicterus.*

CASE 17.—P. S—, aet. 20. Third of six pregnancies. Homospecific. Mother's group, A Rh −ve; defective's, A Rh +ve.

Pregnancy and birth normal. Defective developed jaundice on day of birth and this persisted for about 14 days. He had fits just after birth, and again between ages of two and three. There is now no evidence suggestive of kernicterus. Defective is feeble-minded.

Family history: Eldest sib. died aged 21 of tubercle. Second a. and w. Fourth a. and w. Fifth and sixth pregnancies ended in stillbirths. Otherwise *nil.*

CASE 18.—R. B—, aet. 18. Third of five pregnancies. Homospecific. Mother's group, AB Rh −ve; defective's, B Rh +ve.

Pregnancy and birth normal. Jaundice said to have developed about the third day, but its duration is uncertain. The child was said to have a doubtful positive W.R. when young, and she and her mother attended hospital for injections. Defective's W.R. is now negative. She did not walk or talk till age of seven, and her articulation even now is very defective. She shows definite athetosis and is physically poor in health. She is an imbecile.

Family history: Eldest sib. (by first husband) a. and w. Second (by second husband) a. and w. Fourth pregnancy ended in stillbirth. Fifth sib. a. and w. The mother in this case is herself not very bright, but is not classed as a defective.

CASE 19.—J. C. H—, aet. 12. Fourth of four pregnancies. Homospecific. Mother's group, A Rh −ve; defective's, O Rh +ve.

Pregnancy and birth normal. Defective was jaundiced at birth, but this cleared apparently satisfactorily. Owing to the development of spasticity and athetoid movements of all limbs, defective was unable to attend any school. His speech is poor.

Family history: First two sibs. a. and w. Third died at two days of jaundice. Otherwise *nil.*

CASE 20.—J. T—, aet. 15. Seventh of seven pregnancies. Homospecific Mother's group, O Rh −ve; defective's O Rh +ve.

Pregnancy and birth normal. Severe jaundice developed on the third day, and lasted about three months. Child not expected to live, and she later developed athetosis. In this case the mother's serum agglutinated saline suspended Rh-positive cells, and the reaction was greatly enhanced when the cells were suspended in albumin, a titre of 1 : 8 being obtained. The indirect Coombs test was strongly positive when Rh-positive cells were used, and negative with Rh-negative cells.

Family history: Eldest and third sibs. died at nine months of meningitis. Second is a. and w. The fourth pregnancy ended in a miscarriage. Fifth and sixth sibs. a. and w. All the children were slightly jaundiced at birth. Otherwise *nil.*

APPENDIX B.

Test Group of Cases of Undifferentiated Mental Deficiency showing Rh Incompatibility.

Note.—Unless otherwise stated, there was no history in the defective of erythroblastosis foetalis, nor were atypical agglutinins found in the mother's serum.

1. *Feeble-minded cases.*

CASE 21.—R. H—, aet. 20. First of two pregnancies. Homospecific. Mother's group, O Rh −ve; defective's, O Rh +ve.

Pregnancy normal. No qualified help available at birth. Defective first attended an ordinary school, then special school.

Family history: Second pregnancy ended in a miscarriage during seventh month. Uncle of defective was an epileptic and died in a mental hospital.

CASE 22.—I. M. B—, aet. 18. First of three pregnancies. Heterospecific. Mother's group, O Rh −ve; defective's, A Rh +ve.

Pregnancy and birth normal. Nothing of note in later development, apart from fairly mild mental defect.

Family history: Second and third sibs. a. and w. No history of jaundice. Otherwise *nil.*

CASE 23.—J. S—, aet. 48. Fifth of nine pregnancies. Homospecific. Mother's group, A Rh −ve; defective's, A Rh +ve.

Early details vague, but nothing of note then or in later development apart from mental defect.

Family history: First two sibs. died in infancy; third, fourth and sixth a. and w. Seventh, eighth and ninth (by second husband) a. and w. Otherwise *nil.*

Case 24.—C. A—, aet. 36. First of two pregnancies. Homospecific. Mother's group, O Rh −ve; defective's, O Rh +ve.

Pregnancy normal. Breech birth. Slight jaundice just after birth, duration unknown. Nothing of note in later development apart from mental defect, and nothing to suggest that the early jaundice was of the icterus gravis type.

Family history: Second sib. a. and w. A cousin of the defective, on the father's side, is also a defective.

Case 25.—A. M. W—, aet. 38. Sixth of ten pregnancies. Homospecific. Mother's group, O Rh −ve; defective's, O Rh +ve.

Pregnancy and birth normal. Backward development generally from early age. Fell downstairs and broke leg at four years, with doubtful head injury. Defective always delicate, but on examination no evidence of icterus gravis or kernicterus.

Family history: Eldest sib. died at 10 weeks, cause unknown. Second and third a. and w. Fourth died at 1½ years, and fifth at three years, both of meningitis. Seventh a. and w. Eighth pregnancy ended in stillbirth, mother being unwell due to worry and lack of food. Ninth and tenth sibs. a. and w. Otherwise *nil*.

Case 26.—W. H. H—, aet. 41. Eighth of ten pregnancies. Homospecific. Mother's group, O Rh −ve; defective's, O Rh +ve.

Pregnancy and birth normal. Some jaundice noticed just after birth, but no history of defective having been seriously ill at the time. Backward in general development, and did not walk till aged 3. Thought at that time to be due to paralysis, but now no evidence of this. Was certified under the M.D. Acts in 1924, and under the Lunacy Acts in 1945.

Family history: Eldest sib. a. and w. Second and third pregnancies ended in stillbirths. Fourth to seventh and ninth and tenth sibs. a. and w. Otherwise *nil*.

Case 27.—A. L. W—, aet. 54. Only pregnancy. Homospecific. Mother's group, A Rh −ve; defective's, O Rh +ve.

Pregnancy normal. Confinement very difficult, and it was feared child would be lost. Nothing of note in later history apart from mental defect apparent from an early age and the later development of mental illness.

Family history: Parents were second cousins. Father was intemperate. A cousin of the defective died in a mental hospital.

Case 28.—P. T—, aet. 29. Fourth of four pregnancies. Homospecific. Mother's group, AB Rh −ve, the genotype being r′r (Cde/cde); defective's AB Rh +ve.

Pregnancy and birth normal. Nothing of note in history till he was aged 23, when he developed epilepsy. Life-long defective.

Family history: Eldest three sibs. a. and w. Otherwise *nil*.

Case 29.—J. B—, aet. 12. First of two pregnancies. Homospecific. Mother's group, O Rh −ve; defective's, O Rh +ve.

Pregnancy and birth normal. Nothing in history of note apart from mental defect.

Family history: Younger sib. a. and w. Otherwise *nil*.

Case 30.—D. E. M—, aet. 23. Third of six pregnancies. Heterospecific. Mother's group, O Rh −ve; defective's, A Rh +ve.

Mother had a bad fall during early stages of the pregnancy, but she carried on to term. Birth normal. Epilepsy began at one year and has continued since.

Family history: Other five sibs. a. and w. Otherwise *nil*.

Case 31.—F. B—, aet. 29. Sixth of 15 pregnancies. Homospecific. Mother's group, O Rh −ve; defective's, O Rh +ve.

Pregnancy and birth normal. Defect present from early age.

Family history: First, fourth, fifth, seventh, ninth and thirteenth sibs. died at an early age of physical illness. The rest, eight in all, a. and w. No defectives among them. One grandparent on each side of the family said to be backward. The defective's father was a heavy drinker.

CASE 32.—J. G. P—, aet. 31. Second of eight pregnancies. Homospecific. Mother's group, A Rh−ve; defective's group, A Rh+ve.

Pregnancy and birth normal. Nothing of note in later history apart from mental defect.

Family history: Eldest sib. died at two years, cause not known. Third died at two years of meningitis. Fourth and fifth a. and w. Sixth, seventh and eighth died at one week, two and three days respectively, cause unknown. An uncle of the defective's mother was ill mentally for some years.

CASE 33.—R. L. S—, aet. 18. Third of three pregnancies. Homospecific. Mother's group, A Rh−ve; defective's, A Rh+ve.

Pregnancy and birth normal. Nothing of note in later history apart from mental defect.

Family history: Eldest sib. died at 13 of cerebral tumour. Second a. and w. The mother is a patient in a mental hospital, and her father died of mental trouble (senility or comparable trouble almost certainly.)

CASE 34.—J. H. W—, aet. 34. Third of three pregnancies. Homospecific. Mother's group, O Rh−ve; defective's, O Rh+ve.

Pregnancy and birth normal. Defective has been an epileptic since age of three and a half.

Family history: Eldest two sibs. a. and w. Otherwise *nil.*

CASE 35.—K. J. W. D—, aet. 21. First of ten pregnancies. Homospecific. Mother's group, A Rh−ve; defective's, O Rh+ve.

Pregnancy normal: Forceps delivery, but child apparently normal, and nothing in later history apart from mental defect. Atypical agglutinins were found in the mother's serum, which did not agglutinate saline suspended cells, but agglutinated strongly all the albumin suspended Rh-positive test cells. The indirect Coombs test was also strongly positive. This finding occurred five years after the birth of the youngest sib., but it was impossible to obtain specimens from the rest of the children owing to lack of further co-operation.

Family history: Second, fourth, fifth, seventh, ninth and tenth sibs. a. and w. Third died at 2¾ years of pneumonia. The sixth and eighth pregnancies ended in stillbirths. Otherwise *nil.*

2. *Imbecile and Idiot Cases.*

CASE 36.—J. G. D—, aet. 20. First of two pregnancies. Homospecific. Mother's group, O Rh−ve; the genotype being either r′r (Cde/cde) or r′r′ (Cde/Cde); defective's group, O Rh+ve.

Pregnancy and birth normal. History of fits from six months to 2½ years. Otherwise nothing of note apart from mental defect.

Family history: Second sib. a. and w. Otherwise *nil.*

CASE 37.—E. A. S—, aet. 42. First of four pregnancies. Homospecific. Mother's group, A Rh−ve; defective's, A Rh+ve.

Pregnancy and birth normal. Epilepsy present since age of 13, but mental defect was evident from an early age.

Family history: Difficult labours and instrumental deliveries at all confinements after the first. Second and third sibs. a. and w. Fourth pregnancy resulted in twins, one being a. and w., the other dying aged 6 of diphtheria. No jaundice in any of these sibs. at birth. Otherwise *nil.*

CASE 38.—S. H—, aet. 15. Only pregnancy. Homospecific. Mother's group, O Rh−ve; defective's, O Rh+ve.

Pregnancy normal. Umbilical haemorrhage at birth, after prolonged instrumental labour. Epilepsy present since age of two.

Family history: *Nil.*

CASE 39.—M. B—, aet. 34. First of three pregnancies. Heterospecific. Mother's group, O Rh−ve; defective's A Rh+ve.

Pregnancy and birth normal (seven months).. No jaundice developed, but defective was anaemic and delicate. Fell out of bed when a few weeks old, but no evidence this had any bearing on the mental defect, although the forehead was injured.

Family history: Second sib. died at ten weeks, said to be due to T.B. of bowel. Third sib. a. and w. No history of jaundice in either case. Otherwise *nil.*

CASE 40.—E. M. G—, aet. 36. Second of six pregnancies. Heterospecific. Mother's group, O Rh−ve; defective's, A Rh+ve.

Pregnancy, birth, and later history normal, apart from mental defect.

Family history: All the other five sibs. a. and w. with no history suggestive of erythroblastosis. Otherwise *nil.*

CASE 41.—B. M. B—, aet 7. First of four pregnancies. Heterospecific. Mother's group, O Rh−ve; defective's, A Rh+ve.

Mother had chronic nephritis and pregnancy was terminated four weeks early. Birth normal. Defective had blood transfusions from mother at two months because of attack of gastro-enteritis. Subsequent history normal apart from defect.

Family history: Induced labours for all the sibs. owing to the nephritis. Three younger sibs. a. and w., but last child was slightly jaundiced at birth. Otherwise *nil.*

CASE 42.—P. E. B—, aet. 9. First of two pregnancies. Heterospecific. Mother's group, O Rh−ve; defective's, A Rh+ve.

Normal pregnancy. Breech delivery, one week overdue. Baby "slate-coloured" at birth and he had two transfusions from father on same day. No actual jaundice developed. Defective said to have had meningitis at three years, but there is no evidence that defect was due to this.

Family history: Younger sib. aet. 5, a. and w. He also is Rh+ve, with no history suggestive of erythroblastosis, so that defective's condition at birth could in no way be related to iso-immunization. Otherwise *nil.*

CASE 43.—A. F—, aet. 12. Second of three pregnancies. Heterospecific. Mother's group, O Rh−ve; defective's, A Rh+ve.

Pregnancy, birth, and later history normal apart from defect.

Family history: First and third sibs. a. and w. Mother has suffered from thyrotoxicosis.

CASE 44.—C. R. H—, aet. 16. Seventh of eight pregnancies. Homospecific. Mother's group, A Rh−ve; defective's, A Rh+ve.

Mother had a fall while pregnant and this caused a large "lump on the privates." This was removed and baby was born a few days later, a fortnight prematurely. Birth normal. Epileptic fits occurred between aged of 4½ and 12 years.

Family history: First pregnancy ended in stillbirth at 7½ months. Second, third and fourth sibs. a. and w. Fifth died aged 11, said to be due to diabetes. Sixth pregnancy ended in miscarriage at 4½ months. Eighth sib. a. and w. Otherwise *nil.*

CASE 45.—B. D. J—, aet. 26. Fourth of six pregnancies. Homospecific. Mother's group, A Rh−ve; defective's, O Rh+ve.

Normal pregnancy: Caesarean birth at 8 months. Defective always delicate and for first 12 months was stated to be in hospital receiving blood tests and injections, but the hospital in question could find no trace of this individual in their records. She now shows no stigmata of syphilis, and there was nothing else of note in her history apart from mental defect.

Family history: First pregnancy ended in stillbirth, and second sib. died at ten weeks, cause unknown. Third pregnancy ended in stillbirth (eight months), and fifth in miscarriage (four months). Sixth sib. a. and w. Otherwise *nil.*

CASE 46.—W. J. R—, aet. 21. Second of five pregnancies. Homospecific. Mother's group, A Rh−ve; defective's, O Rh+ve.

Pregnancy and birth normal. Defective fell downstairs at eight months, but no evidence that this had anything to do with the mental defect. Nothing else of note in later history.

Family history: First sib. a. and w. Third, fourth and fifth pregnancies ended in miscarriage. Otherwise *nil.*

CASE 47.—L. M. S—, aet. 11. Only pregnancy (twin). Homospecific. Mother's group, O Rh −ve ; defective's, O Rh +ve.

Pregnancy and birth normal (eight months). Defective had severe diarrhoea at ten weeks, but later history normal apart from the mental defect.

Family history : Other twin a. and w. Otherwise *nil.*

CASE 48.—G. J. P—, aet. 17. First of two pregnancies. Homospecific. Mother's group, A Rh −ve ; defective's, O Rh +ve.

Pregnancy, birth and later history normal apart from defect.

Family history : Second sib. a. and w. Great-aunt was mentally ill, and granduncle was said to have committed suicide. Both were on father's side.

CASE 49.—J. C. A—, aet. 32. First of two pregnancies. Homospecific. Mother's group, O Rh −ve ; defective's, O Rh +ve.

Pregnancy normal ; instrumental delivery at eight months caused bruising on head. Defect first noticed at about two years. Nothing else of note in subsequent history.

Family history : Second sib. a. and w. Otherwise *nil.*

3. " *Heredity* " *Cases.*

CASE 50.—B. G. C—, aet. 11. Sixth of seven pregnancies. Homospecific. Mother's group, A Rh −ve ; defective's, A Rh +ve.

Mother had kidney trouble during last six weeks of pregnancy. Defective a twin, dissimilar. Birth and subsequent history normal apart from mental defect. Defective is an imbecile.

Family history : Other seven sibs. a. and w. An aunt and uncle of defective on father's side are imbeciles. Another aunt on father's side is in a mental hospital.

CASE 51.—H. R—, aet. 19. Eighth of 15 pregnancies. Homospecific. Mother's group, A Rh −ve ; defective's, A Rh +ve.

Mother had pneumonia during late pregnancy and was very ill during and after birth of child. Later history normal apart from mental defect. Defective is feeble-minded.

Family history : First sib. a. Is a discharged defective. Details of rest of family not clear. Three died in infancy of physical illness ; there was a stillbirth about the tenth pregnancy, and also a miscarriage; position in family sequence not known. The mother herself seemed of poor intelligence. Eldest sister of defective is feeble-minded. Two cousins, brothers, are both feeble-minded with superadded schizophrenia.

CASE 52.—C. Y—, aet. 30. First of two pregnancies. Homospecific. Mother's group, A Rh −ve ; defective's, O Rh +ve.

Pregnancy and birth normal. Defective and mother were knocked down by a motor cycle when he was aged two years, since when he has not spoken. There is no evidence that this was the cause of the defect, and there is nothing of note in the later history. Defective is feeble-minded.

Family history : Younger sib. a. and w. The mother is feeble-minded. The father was in a mental hospital for many years. A half-sister of the defective (same father) is an imbecile.

ACKNOWLEDGEMENTS.

I wish to express my gratitude to Mr. Westmorland and his staff, of the Mental Deficiency Department, City of Nottingham, and to Miss House, of the Mental Welfare Department, City of Birmingham, without whose co-operation this research could not have been carried out.

My thanks are also due to Dr. E. F. Aubert, of the Regional Blood Transfusion Service, Sheffield, and to Dr. W. Weiner, of the Regional Blood Transfusion Centre, Birmingham, who kindly agreed to carry out the technical examinations on the bloods of the Nottingham and Birmingham cases respectively.

I much appreciate also the willingness of Dr. J. A. H. Waterhouse, of the Medical Statistics Department, Birmingham University, to analyse my figures statistically and calculate for me the expected percentage of Rh incompatible pregnancies.

I have also to acknowledge my indebtedness to the Mental Deficiency Committees of the cities of Nottingham and Birmingham for permission to carry out this work.

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FRUSTRATED AMBIVALENCE OF THE MATING INSTINCT.

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[Received 26 October, 1949.]

Sexuality is ambivalent because love is expressed biologically in the primitive terms of life—we kill or we die. Mating, according to the psycho-somatic theory of family sexuality (Turner, 1947), is accomplished by a portrayal of the conditions of the hunt. The male portrays his hunting of the inferior species. The female in mating, therefore, is identified with the inferior species until the orgasm, when she is identified with the superior species which kills the hunting male. The female loves the male, who pledges his hunting, and the male loves the female, who pledges herself by enacting the environmental realities which he meets when hunting. Thus the young are provided for in ambivalence by a hunting father, and by a mother who teaches them to hunt by presenting to them the conditions of the hunt. Thus by further sublimation of the primitive ambivalence the father is the civilized breadwinner and the mother one's first guide, philosopher and friend.

It should be appreciated that the psycho-somatic sexual theory of the family describes the emotions of the sexual act as exhibiting the emotions of daily life. The male who hunts in daily life, in coitus exhibits hunting. When hunting he risks his life, and he portrays his death in the orgasm. The female in her daily life of motherhood provides a sense of the quality and reality of the environment to her children that they may learn their way of life, and in mating she again provides this sense of the environment in which the hunter exhibits his hunting and death.

The daily life of the family may be regarded conversely as a sublimation of their sexual emotions. It is in this sense that this paper describes symptoms of anger and fear in daily life as being sexual.

The anger and fear are often not noticeable in health, for we are unaware, usually, of the emotional content of our instincts unless they are frustrated (McDougall, 1940). Thus the dog chasing a rabbit to kill it appears merely to be running, but if it is frustrated in its efforts one hears the bark, and sees the hair bristled and the teeth bared, and one is aware of the anger which passed unnoticed when the dog was not frustrated in its hunting. Yet the dog had been using the emotion of anger to run after the rabbit. "Emotion moves us, hence the name." The dog which is not going to bite, on account of disinclination, training or external impediment, is often the one which barks loudest, and the instinct to bite, being frustrated, is obvious in the barking.

Again, a person who is running away from an enemy and is showing a clean pair of heels shows no other sign of fear. But should his path be barred and his enemy begin to catch up on him, then will be seen the staring eyes and the nervous agitation proclaiming that it was with fear he had been running.

Similarly, in the realm of physiology we are unaware in health of the visceral peristalsis, but the latter is evident most painfully in intestinal obstruction.

Thus I assume that symptoms of ambivalence denote frustration of the normal ambivalence of sexuality. The ambivalent emotions, having been frustrated and having therefore become obvious to the patient, have been viewed by the patient with alarm, for although the common philosophy of people acknowledges a certain degree of association of love with anger and fear, the intimate association of these which they find in themselves when frustrated, is more than they can understand or appreciate without aid. The ambivalent emotions, having been frustrated, then become rejected also, and the symptoms of illness represent these frustrated and rejected emotions.

It is my custom in psychotherapy to give an outline of the theory immediately the patient has declared symptoms which can be explained by it. I then deduce and explain the aspect of sexuality which has been misunderstood. I find that it gives great encouragement to patients to find that their symptoms can be regarded as misunderstandings of normal and valuable love. They feel reassured, and having said that they have never looked at it that way before, they straightway declare more of their intimate troubles.

The theory is also a great help to the psychiatrist in disposing himself to listen to the patient's troubles, for he knows that, instead of having to interpret on a pathological basis only, he has something of good news about the symptoms to tell his patients.

The next stage in treatment is to find the cause of the frustration, which may require slight or deep analysis. One may then encounter well-known mechanisms of the mind which relate to ambivalence, but there will often be omission to mention these mechanisms in the précis to follow, whether or not they have been considered with the patient in any particular case, for it will suffice if this paper establishes that a psycho-somatic theory of ambivalence as an integral part of normal sexuality is useful in psychotherapy, if the patients are to convert their emotions from symptoms to healthy living.

That we marry " for better, for worse " is stated verbally in the marriage service, and is implicit in the ordered sequence of the coital act. Thus it is good for the family to hunt their prey, but bad, of course, to be hunted.

The first section of this paper will describe the aberrations of ambivalence in men and women who are orienting themselves to the family's need for what is good in the environment; and the second section will describe the aberrations of ambivalence in other men and women who are orienting themselves to what is harmful in the environment.

The third section will consider ambivalence relating to both the good and the bad in life as it disturbs the affections of a series of women, and the fourth section will repeat the consideration of ambivalence regarding both the good and the bad in life, as exhibited in the symptoms of a series of men.

All case-histories in this paper are of out-patients. By excluding case-histories of in-patients one wishes to emphasize that the ambivalent emotions to be described are compatible with the patients concerned being socially acceptable.

Each case-history is presented as a précis of that part only of each case which is appropriate to the particular aspect of the subject of ambivalence in family sexuality which it is illustrating.

Nor is it held that the element which is chosen for description from each case is characteristic of the diagnosis. The aspects of each case have been chosen only to illustrate the theory. This method has been chosen rather than the full account of a few cases in order to show the varied application of the theory of normal ambivalence which is possible in clinical practice.

I. *Ambivalence Expressing in Love the Need for the Good Things in the Environment.*

This section will describe a selection of patients whose symptoms represented a frustration of that part of sexuality which portrays either the human hunter or the desired death of his prey.

B. Y—, a single man aged 31, diagnosed as an immature personality, complained of "continual nervous tension," being worried over details, and of having no self-confidence. He complained of difficulty in making decisions. Anything that altered his way of life upset him; a dispute would leave him shaky, and he often had to remind himself he was a grown man.

He said it was just as if he wanted Mother to decide for him; he had to give up work repeatedly on account of the symptoms of his immature personality.

Much repressed aggression was found during seventeen psychotherapeutic interviews in five years. Free association in several interviews led him to thoughts of his mother's death: he remembered that at 10 to 12 years of age he would lie awake dreading the time when she would be dead (although his mother did not then show any signs of dying). He was attached very closely to his mother, with whom he quarrelled constantly. He would sometimes fear that he would lose control of himself and stab her. At the age of 7 he used to have awful thoughts of what would happen if he did it; and so he came to avoid all causes of death, and was a very timid boy.

It was deduced by me that he was misunderstanding what were valuable sexual thoughts, not recognized by him as such. He was told the psycho-somatic theory of family sexuality and its explanation of ambivalence. The emotional situation of his childhood was also related to the needs of the future, should his hoped-for marriage mature. It was explained to him that his repressed childish aggressiveness towards his mother, whom he loved, implied a childish demonstration of a potentiality of confident manhood.

He was told that this quality of aggressiveness was, when understood rightly, sublimated properly and directed into his work, most valuable to him as a responsible adult.

It was pointed out to him also that, when in due course he married, his wife would expect this quality in him, and would hope that he would pledge it with her in their sexual intercourse.

He did marry later and settled down well to work also, managing a business of his own, making his own decisions manfully.

He was able to sublimate a man's duty to hunt for his family, for he had accepted the psycho-somatic sexual significance of his early phantasy of stabbing his mother.

G. I—, a single girl of 20 years, was diagnosed as incipient hebephrenic depression. She was solitary, and unable to make friends. In describing her illness she was incoherent in describing many visceral symptoms.

The psychotherapeutic consideration of her hebephrenic tendencies as such is irrelevant to this paper, and indeed, although she recovered from the worst effects of the illness and enjoyed her work, she still did not find it easy to make friends.

It transpired, as the treatment progressed through twenty-three interviews in fifteen months, that she had had a fear of death since puberty at 14 years of age. In this particular respect she was evidently misunderstanding her sexuality, as many another girl has done.

At 15 she had threatened suicide because her boy friend was breaking off a love affair. As adolescence developed, ideas of death were often in her mind, and she had less and less to do with boys.

She told me she thought there must be something wrong with herself: but she was reassured that in respect of her ideas of death she was merely making a mistake about her sexuality. She was told the normal place of fear of death in a woman's sexual desire of love and in her attractiveness for the opposite sex. She was, as it were, "dying" to be kissed and wishing for the "lady-killer," to which she quite agreed.

At a later stage in the treatment she asked about superstitions, for example about wearing green. Free association on green proceeded thus—grass—cemetery—grave—me lying there—man at the office. She was therefore recommended to wear green. Asked for another superstition she gave "walking under a ladder." Free association gave—it is only unlucky if a man is not on it! She began to realize that in respect of her fear of death she was normal emotionally after all, for she was appreciating the good that was latent in her ideas of death.

Z. T—, a girl aged 15½ years, suffered from hysteria with schizophrenic tendencies. Four months before being seen she had had an attack of depression, when she would "blush at nothing." She became very apologetic for fancied ills she had done the family, and made herself a nuisance by persisting in waiting on the family. She would bruise herself and say she did not want to go on living, and asked the family to kill her. This lasted a week, and then was repeated for another week shortly before seeing me.

After further inquiries I asked her what was happening in her life at that time, and she told me that just before her first attack she heard that her boy friend had been accused of getting another girl pregnant but that it proved later that this was untrue. Her second attack of wanting to be killed by her family was after she had given up this boy friend because he seemed more interested in someone else. Now she had got another boy friend. It was explained to her in terms of the psycho-somatic theory that her love having been frustrated by her first boy friend's disappointing behaviour she had felt the normal emotions of sex unhappily. She had merely, as it is said, been dying for love, though in an unstable adolescent fashion. She was feeling better now because she had found another boy friend. There was no need now to ask the family to kill her, for she had found her own "lady-killer," and that meant someone who, when she married eventually, would do the indispensable and good thing of hunting for the family as the bread-winner. Ambivalence was thus restored to her and everything was at ease.

She was only seen on the one occasion, and it was hoped there would be no need for a lengthy treatment. The first follow-up visit by the psychiatric social worker, a few weeks later, confirmed that she was still well. It was reported, "She wonders how she can have been so silly" to behave as she did, but she did so again. Her symptoms returned, and it was evident that she needed further inquiry into the development of her personality, to elucidate why her normal sexual ambivalence for the good things of life (that is for her family killing prey for food) should be so disorganized that stress in her life should disturb her behaviour unduly, so that she said she did not want to go on living and asked the family to kill her.

A. C—, a young man of 26 years, had been married for a year. He had a compulsive symptom of a desire to strangle his wife. He was therefore frightened to be left alone with her.

He was told the psycho-somatic theory of coitus, and that his symptom was therefore an aberration of normal feeling. But why should it have gone wrong with him? He says the desire first came to him after their holiday the previous year. He and his wife had decided to have a child, and had started normal coitus on the holiday instead of coitus interruptus as had been the case in the previous months of marriage. It was pointed out to him that with the decision to have a child his wife would want to know all the more that he was a good hunter, and to receive, in coitus, his pledge of his services as such for the hoped-for child.

I saw him again the following week when he had had no further urges to strangle his wife. He said he no longer felt he did not know "what to put it down to," and had not minded so much being left alone with his wife. It was again pointed out to him that the urge stands for something valuable. He was seen for the third and last time three weeks later, when he was quite light hearted about himself, did not mind staying alone with his wife and had never given his obsession a thought.

The psychiatric social worker visited a year later and was told that there had been no return of his symptoms. He was very grateful for what had been done for him in the few interviews he had had, and in the event of a relapse of symptoms he would not hesitate to return for treatment again.

These cases have illustrated that to love and live, a man must accept the primitive need to kill and a woman must accept the emotions of the desired prey. This is the meaning of coitus up to, but not including, the stage of the orgasm, and frustration of the genital or sublimated expression of these emotions reveals their nature in the form of symptoms.

II. *Ambivalence which Acknowledges in Love what is Harmful in the Environment.*

This section concerns emotions which are expressed in the orgasm as a dramatic representation of tragedy. The man, when hunting, is exposed to being killed by a superior species, that is, by a non-human force. It is fitting and proper that this risk, inherent in his duty, and inculcated by her in the offspring, should be acknowledged in love, for we marry for better, for worse.

P. N—, a married woman aged 32 years, who had been a Sunday School teacher and superintendent for many years, suffered from anxiety neurosis.

There was a history of perspiration, fainting, palpitation and pain in the left side for nine months. In her fainting attacks she would see rapidly changing pictures "in front of my eyes"; she said her mind was "conflicted and confused," and that she had been "unbearably depressed," and had slept badly. She had, she said, an unexplained guilty feeling.

At her third interview she complained of distressing "wrong thoughts" which were just the opposite of what she wants to think, e.g. that she does not love her husband—that his continued asthma might lead to their separation—and as if she might do away with him. He had sustained his illness by being gassed when doing his duty fighting for his home and country. At the sixth interview she told me that her illness started when she opened a registered letter from the Ministry of Pensions to her husband, detailing his record of illness: she "realized" then that he had been more ill than she had thought, and she went "numb" and "taut." When, later, her husband was worse with asthma and coughing and had to be X-rayed it resulted in her losing her "feelings of love" for him; this tormented her. She also, at another time, told me that her emotional feelings dried up similarly when her father died suddenly when she was 14 years old. She had, on these occasions, put all her energies into her work until she had "snapped" and gone weak and helpless.

Puberty came early to her, at 10 years of age, and she was satisfactorily adjusted to her emotions, but from the time of her father's death she found it hard to show her feelings, e.g. at giving a demonstration of music lessons, in case the sexual element in her should be detected, and later she could not feel for her ill husband.

She was told quite early the psycho-somatic theory of coitus, and she was often advised on the sexual acceptance by the orgasm of the mortal danger experienced by the male when he is out hunting. It was pointed out to her that her father's death, and the possibility, as she feared, of her husband getting pulmonary tuberculosis and dying were not the result of her feelings, which need not therefore "dry up" or cause her to go "taut." She could only be responsible for their deaths if she actually killed them. She came to another interview complaining that she had had a very bad week—thoughts and feelings—wanted to go out of the house—(if you didn't ?)—would go mad—(and then ?)—sit down—(and, if not ?) —do away with my husband. She was advised to express these feelings about external reality to him in tenderness, and not to inhibit them because her father died actually.

She recovered steadily from her symptoms, and established normal sexual relations with her husband physically, and also for the first time, she said, emotionally. She was no longer over-inhibited sexually on account of the death of her father, or the possibility of the death of her husband ; rather, she acknowledged these dangerous possibilities sexually.

She had fifteen interviews in six months. When visited eighteen months later by the psychiatric social worker, she said that, although she had occasional days when she had some return of her symptoms, she kept very well.

V. H—, a married man, 27 years of age, was diagnosed as suffering from incipient hebephrenia.

He said he did not enjoy anything and had difficulty in getting on with others. He was depressed, had a general feeling of disaster overtaking him, and he complained unduly of the injustices of life. He was incoherent in explaining various bizarre ideas relating to his body, and he had facial mannerisms. He complained of constant frontal headache, saying there was a gap behind the bone of his forehead ; and he said, " Food makes me ache between the legs."

He said he loved his wife—" she means everything to me "—but he felt guilt about having sexual intercourse with her. He was an ambitious young man, always trying to " better " himself by taking instructional courses (concerning his work). He approached the treatment with a determination to discover the cause of his illness ; and in respect of his guilt about intercourse, he said that he did in fact continue to have sexual intercourse with his wife, for he had a fear of losing her if she was not satisfied in the act.

As guilt is associated normally with the idea of punishment, and punishment with the idea of death, his particular guilt about sexual intercourse suggested to me that amongst other psychological factors he had a misunderstanding, for some reason, of the emotions of his orgasm, in which is acted the possible family tragedy of his death ; the subsequent course of his self revelations confirmed my guess.

He also stated, " I love my mother—I hate my father." Since the domesticated father is not only the breadwinner, but also plays a part in the education and training of the children, he often stands, instead of the mother, for the superior species, which can harm the child, and by punishment he warns them of the dangers of their wrongdoing. The mother, who traditionally is often only thought of as the weaker sex, is often identified, by popular ideas, with only the inferior species which it is desirable to hunt. The patient's statement regarding his parents, " I love my mother—I hate my father," may therefore be paraphrased, " I love hunting an inferior species for food for the family, but I cannot accept the justice of risking my life to a superior species whilst doing so," which again suggests a faulty unconscious acceptance of the meaning of the orgasm.

In subsequent interviews he gave a piecemeal account of guilt for masturbation, in which one can appreciate that there had been gross misunderstanding of the orgasm by the patient.

The following story was slowly elicited from his unconscious mind, and pieced together and interpreted, and his attitude to it resynthesized during many of the thirty-six interviews he was given.

When he was 19 he went one day to the lavatory at work, and there masturbated, as was his wont up to six times daily. He felt ashamed about it, but in order to keep absolutely physically fit, and to make something of himself he had " left the girls alone " so as not to weaken his body. (This belief, of course, represents a very frequent misunderstanding of the male orgasm.) On this particular occasion his " feeling was high." He had a vision of a woman, seen from the hips up, but without a head, arms outstretched to him ; he imagined he was having intercourse with her and wanted to give her a baby, and he had " gone wild " about it. Then came the sperm and, such was his illusion, it was green ! He thought he was dying. He thought his inside was coming out. He thought his brains were green with decay, for he had always believed " a man gave a woman a baby by his brains coming away with his sperm." Hence, he said, he has ever since tried overhard to get knowledge and to repair his decayed and partly lost brains, which he felt had left a gap behind his forehead. Here, from his unconscious mind, was the explanation of his symptom of frontal headache as if there were a gap behind the forehead.

In his unconscious mind he had felt his father knew about it and was glad, and he felt the foreman at work might know and that it would show in his eyes; he wondered what his mother would say. I assured him that his feelings of dying stood for his willingness to risk his life for his children to be, and that his mother, wife and all of us would like to know that.

However, at the time of the incident he panicked, and when the foreman told him to go downstairs for something, he collapsed at the bottom of the stairs, was taken home unconscious in an ambulance and was in bed for some weeks. "I was never the same after that, nor so intelligent, and I have a guilty conscience." He had misinterpreted the emotions of the orgasm.

There was much other case material which is not recorded here, for it is irrelevant to the present theme of the rehearsal in the orgasm of the potential death of the male when hunting for the family.

The devastating emotions of the orgasm had not been accepted by him as representing the virtue of male virility, risking its life for the family. His normal emotions therefore showed themselves as symptoms.

The reasons, not all detailed here, why he had been unable to accept his orgasm were explained to him, and he was encouraged to accept this emotion and to express it in his marriage and to sublimate it in his work. He did so and came to regard with equanimity his foreman inspecting his work.

He was discharged from treatment, and a year later he was still maintaining a very marked improvement. He was physically fit and was working in the mines, where he had risen to the position of under-manager.

He maintained his improvement to the end. One and a half years after treatment ceased he died suddenly from acute heart failure during an influenzal epidemic. The reality of death had come to him.

According to the psycho-somatic theory of family sexuality it is normal biology to accept the presence of death and of its causes; and the frustration of genital or sublimated expression of the instinct leads to morbid awareness of the instinct, in cognitive, affective or conative symptoms.

III. *Ambivalence in Women*, portraying their reaction in love to the good and the bad in life.

The following cases have been chosen for their demonstration of the patient's failure in each case to accept, whether genitally or in sublimation, the emotions of both the beginning and the end of coitus.

D. Y—, a woman, aged 46, was seen at the request of the Magistrate's Court, five days after an episodic attack of melancholia, in which she had attempted suicide by gassing herself.

Her husband having left her a year after marriage, she had been cohabiting with another man for twenty-three years and had had seven children, all living, by him. He had left her seven months previously and married another woman, who had since separated from him when she discovered he was already the father of children.

The patient had taken a very sensible view of his behaviour when he had left her, and she had put the children first in her mind. Normal ambivalence had therefore continued for her children.

The man then returned to the mother of his children and slept in the house for several nights, although seldom speaking and never giving any assurance of his future behaviour. Her ambivalence for him was therefore under severe strain. Here was the adult object of her love, but he did not appear to want her love.

He left again, apparently for ever, "without saying a word," and she denied within herself that she loved him, so breaking up her ambivalence. Love no longer controlled the violent emotions of love, and she attempted suicide. It was on the morning that he left her that she unsuccessfully put her head in the gas oven.

She told me she did not want him back, that she did not love him now.

I did not believe her statement, for if her love for him had really left her on his departure, so would her violent emotions have left her. I called her disbelieving bluff, and pointed out to her that she did still love the man ; she then quite agreed and determined wisely to make allowances for this in future. She even added gratuitously that she would be willing to have him back.

This was a much safer and more stable attitude, for ambivalence was restored to her fully, even though the opportunity for its expression was very limited by the default of the man she loved.

I then saw her mother, who thought that the patient and her paramour had meant a lot to each other over the years, which confirmed me in my opinion of the case.

The next case of broken ambivalence is that of a woman whose sexual emotions, being without love and hope, were manifest as fear and cynicism.

U. A—, a single young woman of 27 years, had an anxiety neurosis. She complained that for a year she had had a morbid fear of death. She would lie awake in bed at night and picture herself in a fatal accident. She said she " got keyed up inside and in a sweat," had " pains in chest," headache and sickness ; she continued, " I worry I might cause Tb. to come on or affect my heart " ; " It feels as if a hand is inside me tightening everything up " ; " I am trying to see into the future and am afraid of it " ; " How much longer have I got to live ? "

Explanations were given her of a woman's sexual emotions of desire—how she portrays the frightened little creature she wishes her mate to kill, and how the rejection within the mind of these emotions could leave them expressed in the form of nervous symptoms, as meaningless fear of death.

It was discovered then that she was, and had been for many years, in a bitter and cynical frame of mind, with loss of hope and faith in love. She had a deep-seated bitterness because of the faithlessness of her father, who, she was told, did not stick by her mother when the latter was illegitimately pregnant with her by him. She wished her father, whom she knew by sight, had been faithful but, as he was not, she had concluded she must be wrong to expect faithfulness ; this left her feeling bitter towards her father and men in general. She was therefore in a frame of mind to expect disaster to a family to come by default of the man, and not from an unfavourable environment, and so she fell in love at 23 years of age with a man who, she " knew " in advance, would not be faithful to her. Her mother had constantly taught her bitterness about love, and in this love affair at 23 she, the daughter, had opened her heart wide to bitterness.

The orgasm, according to the psycho-somatic theory, signifies the acceptance of a possibility of familial disaster—the man when out hunting for the family is exposed to mortal danger. He is not killed by his default in the primitive situation, for the tragedy occurs when he is being faithful to his duty. But this young woman's father was not faithful, and it was apparently by his fault that the family life came to disaster ; she had concluded, therefore, that all men were failures due to unfaithfulness, and in her cynicism she despised them. Her normal emotions of the orgasm were not therefore sublimated normally into a love for men, believing them to be by nature ready even to risk their lives for those they love.

She nursed all her feeling for the faithless man, whom she did not trust. Her emotions were therefore of no avail and, being thus frustrated, showed as a morbid fear of death and as cynicism.

She was persuaded successfully that the original little girl who expected faithfulness was right. Ambivalence was restored thus to her and her outlook became less cynical and much sweeter. She lost her symptom of fear of death, because fear was now expressed in a disposition to love someone she might meet in the future, whom she could expect to be faithful. She later became happily engaged to marry a man in whom she had faith.

She was seen on eight occasions in four months. A year later the psychiatric social worker visited the mother, who " says that her daughter has been very well since she finished treatment, and that there has been no return of symptoms."

In the following case, too, the cure was achieved by giving the patient an understanding of the sexual emotions, which were being expressed, all unknown to her, in her symptoms.

L. S—, a married woman, aged 39 years, who had two children, a boy of 13 and a girl of 9 years, suffered from an anxiety state. She was a Sunday School teacher. She said she had dreaded going out alone since the age of 15 years, when she had imagined she was going to get lockjaw, etc., that she would collapse and die or go mad. She had a desire " to run away from the fear."

She had improved a little as the years went by, but had been worse since her second child was born nine years ago. She was frightened of being " hemmed in," and she feared to go out ; she was frightened she would scream and knock someone down. When out alone she continually thought of the next place of " refuge," e.g. her doctor. She found she could not hide her fears from her children, for she would decide to go somewhere and at the last moment she would cancel her plan.

When young she had been warned darkly and obscurely about sex, for her father was very strict about " rudeness " ; and though she was attached to him, she was not comfortable in his presence and felt a " restraint " when talking to him.

She thought that only after the birth of her second child did she " reach a proper experience " in coitus, but at the same time she became more troubled with the emotions of fear and anger in her life.

Thus her symptoms had been associated particularly with the two periods in her life when she had experienced an increase of sexuality, at puberty and after the birth of her second child. She was given explanations in terms of the psycho-somatic theory of family sexuality, of the significance of fear being followed by anger in women, e.g. her desire to scream and then knock someone down.

She started to improve in confidence and went out more on her own. She was therefore beginning to accept her feelings, although she said she had in the past hated to let people know she had any feelings, and even in Sunday School she did not wish people to realize when she was in earnest.

At her third interview the rapport was stable and sufficient enough for her to remember and speak of other characteristics about herself. She said that she had always felt a difficulty about speaking of intimate affairs, which she did not find in her friends. As a child she could not frame the word " bosom " or " breast," even in a hymn, for she would feel very self-conscious and thought people would be looking at her.

She then gave instances of other difficulties which illustrate well the evidence of frustration in the normal sequence of fear and anger in female sexual emotions. In her early 'teens a boy friend sent her a Christmas card and she thought he had gone too far ; she panicked and got furious, stamping about, and burnt the card.

At about 20 years of age she used to walk to work with a man who lived in a house on the opposite side of the road. One day he said she was a nice person and would make a good wife ; she panicked, ran home and there stamped and raged. She experienced a similar reaction in marriage if sexual intercourse went wrong.

The normal sequence of emotions of the female were explained to her again. These emotions were to be accepted in her personality even though she had been brought up in ignorance and with an uncompanionable father.

During the next few interviews it was also necessary to extend the explanation sympathetically to the relation of her emotional life to her attitude to God and religion, for religion was prominent in the organization of her sublimations, but the exposition of this aspect of her case is outside the limits of this article.

After ten interviews in six months she was discharged from treatment. She said that she had been doing very well, going out on her own, the " funny feelings " not bothering her so much, and she had even been on top of trams, about which her children were very thrilled.

The follow-up report of the psychiatric social worker, who visited eighteen months later, reads : " She was quite pleased at being looked up. She says that she is very much better. She can now go out and about on her own without worrying unduly, and she feels that the treatment did her a lot of good. She says, however, that she does get actual return of the symptoms, and she would certainly not say that she was no longer a nervous person. However, she can cope with the symptoms and says that she does not take any notice of them."

This result is regarded as very encouraging in view of the long-standing anxiety state of twenty-four years' duration ; the result was obtained in ten interviews, by explanation of her symptoms and anamnesis in terms of the psycho-somatic theory of family sexuality.

L. I—, a married woman aged 32, who had one child aged 5 years, suffered from hysteria. She complained of headaches, crying, and a fear of going silly, with a desire to rush out and scream. She also complained of " dizzy bouts " in which she would " shake and sweat." The illness had started two years previously with collapse and weakness when she was in bed for nine months, but she was not referred to a psychiatrist at the commencement of the illness.

It transpired during psychotherapy that her illness started when her husband, on discharge from the army, forsook his steady work as a carpenter for gambling and living by his wits. It was sending her silly, she said, that he also would not tell her what he was up to, and her mind could not be at rest. She lost all faith in, and feeling for him. She had a sharp pain in the left side of the lower abdomen, and feared that it had ruined her sexually. It was then that she had collapsed and been in bed for nine months. Previously sexual intercourse had been satisfactory, but she now had no feeling for her husband, and thought it was because there was something seriously wrong with her sexuality.

She was, of course, told the psycho-somatic theory of family sexuality, and in particular that her fears and weakness represented her desire for intercourse, which was frustrated by her unwillingness to give herself in coitus to her gambling husband whom she distrusted. When she appreciated this she was amazed to think how concerned she had been about herself, when she had thought she ought to go to the hospital for an X-ray on account of her weakness.

She also spoke of attacks of " ague," " shaking all over," when worried about her husband's gambling. It made her feel wild, as if she wanted to have nothing more to do with him, nor to let him see how she felt. She would like to " shake " her husband—" I feel as if I would like to wring something out of him." She was advised that these feelings represent those of the female in sexual orgasm, except that they were frustrated by her not wanting to have anything to do with him or to let him see how she felt.

She was therefore reassured that she had her full share of sexuality, but that she was not willing to share it with her gambling husband. She was told that her problem, then, was whether to do without sexual intercourse possibly for life, because she could not give herself to her husband, or whether to lower her standards and give herself to him. She could not accept either alternative, and though she had thought of unfaithfulness, she had decided against that. As she went on talking she came to feel sorry for him, and she was told that was the best attitude she could settle on in the circumstances: to be sorry for him expressed her belief in herself and also her love for him; it expressed the weakness displayed by the female in the invitation to intercourse. and it also expressed the superiority of the female in orgasm; it expressed her belief in goodness and also the recognition of badness; it expressed the sexual recognition of marriage for better or worse.

She steadily improved during the twelve interviews in seven months, during which the above was elicited and discussed. At the third interview she said she had been much better, and had taken more interest in her clothes and other people. After nine interviews in four months she said she had all but lost her symptoms, e.g. she still occasionally had " a fear of going silly, but it goes after ten minutes instead of staying for a week." Her relations with her husband, sexual and social, improved, and before discharge " recovered " she said she had " a more settled mind "—she used previously to think she must be going mad because she " never knew what to think "—it was the explanation of her symptoms, by the psycho-somatic theory of sexuality, which had modified her attitude and enabled her to know " what to think " about her emotions.

A year later the psychiatric social worker reported that, although the husband's misbehaviour continued, the patient was free from symptoms.

IV. *Ambivalence in Men*, associating love with an exhibition of their reaction to the good and bad in life.

In the following cases frustration of ambivalence has made symptoms of the emotions of the hunter in victory and defeat.

I. H—, a married man, aged 54 years, was referred by his general practitioner for " violent rages over nothing. He is losing all his friends and breaking up his family life."

The patient told me that he had always been bad tempered, but for six months he had been getting much worse ; he felt he was losing his resistance to his temper, and more and more he would not give in to anybody, his boss or anyone else. When in a temper he would shout and give untrue personal abuse, saying to people that they had no mental powers and were fit for the lunatic asylum, and so on. If crossed by his wife he would be in a mood to kill and smash up the house. He feared greatly for his own sanity, and was completely willing to tell everything if only he could be cured.

His symptoms proved unmistakably to be sexual equivalents ; the precipitating factor six months previously had been disagreement with his wife over their sexual intercourse. He told me about it at the second interview. " Sexual intercourse used to be twice weekly, but she objected and it came to once a week. She insisted on it being at a special time ; there is always a row before it starts, and I have come to detest her." He had, he said, hit her three times in their married life, and hit her hard—it was over sexual difficulties. The other weekly occasion used to be downstairs. She insisted on sitting in a chair and he had to kneel on a cushion, which he said was humiliating to him and against his religion, for he held that a man should get on his knees to no one but God.

When a patient has told me so much of his distressing story, I endeavour straightaway to assuage his guilt and misapprehension by telling him, in the light of the psycho-somatic theory of family sexuality, of the normal aspect of his story.

Coitus was therefore described to him as an act of love by which he demonstrates his primitive powers as an aggressive hunter and his willingness to risk the humiliation of death. He cannot evade these emotions in sexual intercourse, but he can believe in a happier and more loving expression of them than he and his wife had achieved.

This information loosened the patient's reserve, as is usual, and he told me more. He said that he had told his wife that if he went mad, it would be due to her brutality and the brutality of other women, including his mother. When he was 3 years old, and his father was dying, he screamed and his mother thrashed him. It may, of course, have been due to her distressed exasperation, or his memory may have exaggerated what happened, but that was how he remembered it, and he had not forgiven his mother. She also thrashed him with a buckle and strap when he tried to run away from home at the age of 7 ; she thrashed him till she could thrash no more. This again may not have been exactly so, but that was his memory, and he had not forgiven her.

He was now given a further explanation of the primitive direct expression of the world which may harm them given by a mother to her children in suckling and in scolding them. That is normal, but his own mother had not conveyed her love or the meaning of her violence to him. Thus, when he was alarmed by the presence of death in the family, his mother had been frenzied in her primitive duty of bringing home to him that death is a reality which he must accept and fear. Again, it had been with frenzy that she had instructed him regarding the danger which threatens a child away from home ; I wished him to remember that, underlying her cruel treatment, there had been the valuable primitive love which a mother shows when she impresses the reality of danger upon a child. One could only wish that she had done the same duty less painfully and more lovingly, as, for example, in the basic example of suckling ; for the mother's duty thereafter is to impress dangerous reality upon a child by sexual sublimation, in pleasurable play or kindly advice, to save it learning at first hand of danger by harmful bodily distress.

At the next interview, which was a week later, he reported distinct improvement. He had been aware of incidents in which, previously, he would have flown into a temper, but on these occasions he had not done so.

He could now remember further painful memories from the past. Thus at seven, for example, a dark-haired school mistress caned him, he said, in error for another boy who had spoken in class. He rebelled and the six strokes were repeated on each hand ; but he rebelled twice more, and twice more he was caned till his hands swelled up to his forearms.

For this his mother, next day, assaulted the school teacher, and after that he himself was expelled. Ever since that time he has been unable, he said, to be friends with dark-haired people, and has gone out of his way to be cruel to them.

He was advised that it is the duty of adults to impress the fear of dangers on a child, and this at least the dark-haired teacher was doing. If his dark-haired friends remind him of the dangers that beset him, that is all to the good and if to that they, unlike the school teacher, add friendship, that is better still. But at the time of this and other incidents there had been aroused in him a deep, resentful anger which was not recognized by him as being associated with love—ambivalence had broken down and he had been left with most gruesome sentiments.

At 17, he continued, a cousin tempted him to sexual intercourse, and just before penetration she ran off, saying that that was how babies were born. For many years after that he loathed women and would have nothing more to do with them. I persuaded him he was carrying around with him the emotions of sexual intercourse without the love attached normally to them. He had not understood his emotions, nor allowed them to pursue their course in a spiritual way by understanding the girl.

At the next interview, a fortnight later, he reported " very great improvement " ; there had been " no flare up," and he was " not making so many blunders at work." Some insomnia continued, however, with " drumming in the ears like the noise of a sea shell," and sometimes he awoke with a suffusion of the right eye. Some more difficulties, relating to the present and to his experiences in the 1914–18 war, were discussed in the same vein as above, and a fortnight later he again reported a continued improvement.

His hopes were discussed with him and the treatment was reviewed. He said that he was quite calm and felt altogether better—that he had only come to me just in time, for he had felt like killing, and had been on the point of smashing the house and running away. He was discharged recovered after seven interviews in eight weeks. Ambivalence had been restored to him in a large measure. That is not to say that his temper was no longer violent in the following years, for it was habitual for him at the age of 54 years to be bad tempered, but this was now within bounds, and was associated with sufficient respect for others to make ambivalence possible ; indeed, my follow-up letter of inquiry, two and a half years later, elicited that he had progressed favourably.

M. E— was a single young man, aged 23 years, who had an hysterical paresis of the left arm. He was a pleasant, simple and dull individual, " the baby of the family," who was brought for treatment by his mother.

The paresis followed an accident at work, when he was 15 years of age. He was, he said, standing on a pile of cardboard to reach a shelf. The cardboard slipped and appeared to come towards him as he fell. He lost the use of the left arm and " went unconscious."

The story seemed so flimsy that he was asked naïvely what it was like when he was unconscious. " Pain," he said, pointing vaguely to his left shoulder. His arm had improved soon after the accident, and then had got worse after he had been given up by a girl friend whom he had known for three weeks. He said he lost faith then in women, but at the time of coming for treatment he had another girl whom he could trust.

As he spoke of the girls I noticed that he held his left paretic forearm and wrist limply in the right hand, with the left hand hanging down.

He was much too simple and exhibited too much " belle indifférence " to attempt discussion of unconscious motives, so he was asked straight away at the second interview to gaze into the side of a glass of water. [Wolberg (1946) describes this technique. He advises that the patient should be hypnotized deeply first, but I find that this is unnecessary, for the patient is hypnotized merely by gazing into the glass. The technique is also useful for gaining insight into the unconscious mind of some others who are not simple.] He was told to tell me what he saw. At first he saw nothing, and then he saw the disturbing factor of his illness in its stark sexuality.

He saw a hand grabbing something, " something big—the hand is coming round a girl's face—goes to throttle her—it is as if he wants to get something from her—the right hand throttles her while the left holds her to him while he has sexual intercourse with her—he then leaves her—he appears to be that type of man " ; the picture then faded.

It was the duty of his psychiatrist to accept his account of his gazing with equanimity. It was pointed out to him that he saw a hand and suffers from paresis of a hand.

At the next interview he attempted gazing but saw nothing. In discussion he admitted to feelings and ideas, at the age of 14 years, similar to the pictures which he saw at the previous interview, but these feelings and ideas had not persisted after his accident and injury to his arm. I made the suggestion to him that he did not any longer need a paralysed arm to stop him behaving thus, but he did not see the connection, apparently.

At the fourth and last interview he reported having had severe pain in the upper part of the left arm over the week-end, and he gave the explanation that he thought it must be due to turning a wheel at work: this explanation was regarded by me as a rationalization, for he admitted that he always turned this wheel at work, and without sustaining pain previously. He was again asked to gaze in the glass of water; after an unsuccessful interlude he saw something dark and said, "It is the man I saw last time—the sort of man who treats women badly—but he has a nice face which the girls like—his mackintosh is like the one I am wearing—he is 23 years old—and—it might be myself. His arms are all right. There is no girl present." "Is it," I asked, "possible for him to have his arms all right and yet be decent to the girls?" "Yes," he replied. "Then I hope your arm will be all right." "Yes, so do I," he said.

It was concluded that the hysterical paresis had been a safeguard to him against disreputable behaviour. Instead of his unconscious phantasy being the romantic one of loving a girl to whom he was so devoted that he would willingly fight and die for her and their children, it had been of subjugating her and then leaving her. The coital portrayal of killing had been displaced to throttling her, and the portrayal of death by the orgasm was displaced to paresis of the left arm to stop the unworthy behaviour to which he had been inclining.

He did not keep his next appointment, and when the psychiatric social worker visited three months later she saw the patient's mother who "is far from well herself . . ., she says that after a few interviews he was really very much better, and she feels that he should have persevered with the treatment and she thinks that he would have improved. As it is, he is just the same as he was before he started treatment; also he never perseveres with a job, having had a number, and at the moment has continued in one for four days. She points out that he is now a man, and she cannot run after him any more, although that is what he seems to demand." It would appear therefore that, because of his "belle indifférence" and irresponsibility, the treatment had lapsed immediately there was a significant improvement.

It may be that his lack of male aggressiveness in not persevering with his work and treatment was associated with his repression of his sexual instinct, due to the aberrant form to which it tended, as shown by the visual phantasy he had on gazing into the glass of water.

This case, then, has been given to illustrate how the failure of this simple and upright young man to adjust to ambivalence, which demands love in association with the sexual demonstration by the male of killing and being killed, resulted in his disabling symptoms.

R. I—, a single young man aged 19 years, had suffered from severe headaches, frequent "black-outs" and "worry over everything" since returning from fighting with the army in Holland.

The onset of his illness was in the army and was, according to the medical history, of schizophrenic nature. This phase had been followed by an anxiety state, and later still the illness had resembled hysteria. He was invalided from the army and was seen for the first time, by me, six months later, after admission to a general hospital, in a condition diagnosed there as "functional syncope."

He told me that he worried over everything, that he kept going to the police to inform them that the man next door is threatening to murder a woman. He thought that his symptoms dated from shooting a British soldier accidentally (the shot man should not have been in front of the lines), and from being "blown up" by a shell a few days subsequently. In view of the history, it was assumed by me at the interview that the memory of these two incidents, the one following and representing punishment for the other, were of great, though repressed, emotional significance to him, and that the hysterical fainting represented the repressed material trying to escape the censor. It was decided to give him straightaway at the first interview an explanation which he could accept in consciousness.

He was told the psycho-somatic theory of family sexuality, and it was pointed out to him that in coitus the warrior male demonstrates to his wife his ability to kill, and his willingness to brave mortal danger. It was pointed out that it is thus a laudable instinct to impress others with one's loyal efficiency, but that he did so with such unfortunate effectiveness, to this British soldier, that he is now repressing the basis of his normal rapport with others. Moreover, he was told that he probably accepted being blown up after the unfortunate shooting as a punishment instead of as a natural risk of war, which a male normally demonstrates in love by showing he is alive to the possibility of his own death.

He was put on the waiting list for psychotherapy, but when he was next seen, four months later, he reported being symptom-free since a week after the previous interview. He was "feeling fine, and settled in a good job." He had had no further headaches and no "black-out" for two months. He said he had understood the explanations I had given him and that he had found them helpful. He was seen for the third time two months later again, and, being still symptom-free, was discharged from treatment.

It was gratifying that he should have shown such early improvement, but one was doubtful, nevertheless, of the prognosis, in view of the schizophrenic nature of his disorder when he was in the army.

His affection for the army was deep, for he had uncles and cousins in the army; he regretted he could not follow in their footsteps, and felt he would miss the comradeship of the army. One wondered whether the accidental shooting of a British soldier had disturbed some unconscious homosexual tendency to which his ambivalent emotions were attached; it is not opportune, however, to delve deeply into the psyche of every patient, and he was discharged.

I heard eighteen months later that although he had found an extremely nice girl, who reciprocated his affection, and although he had become sociable and had made some good friends, had joined his father's cricket club and was for the first time showing a real interest in the sport, he was still having some attacks of "functional syncope." One concluded that there were some unconscious factors pertinent to his attacks of syncope which had not been elicited.

I noticed with gratification that the free-floating ambivalence for the opposite sex, which had worried him in the form of an idea that the man next door was threatening to murder a woman, was now accepted into his personality, so that he was courting and finding the love of "an extremely nice girl." No doubt the girl herself played the principal part in causing this metamorphosis in him, but I like to think that the psycho-somatic theory of family sexuality had made it possible for him to appreciate her, instead of worrying about ideas such as the man next door threatening to murder a woman.

Conclusion.

The regularity with which patients, some of whom have been mentioned in this paper, accept and benefit by being told the Psycho-somatic Theory of Family Sexuality in explanation of their symptoms, encourages one to believe that the theory gives a true explanation of a normal incidence of ambivalence.

It is the province, therefore, of psychotherapy to assist patients to re-orient themselves with regard to their ambivalence so that its pathological manifestations may be neglected in favour of normal ambivalence, despite the frustrations of life.

Acknowledgment.

I should like to express my thanks to Miss F. M. Green, Psychiatric Social Worker of the Towers Hospital, for the follow-up reports.

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THE PATTERN OF FRIENDLINESS AND DOMINANCE IN A THERAPEUTIC GROUP.

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[Received 16 November, 1949.]

The complex interpersonal relationships which establish themselves when people meet and interact reveal a number of bipolar aspects or trends, such as liking—dislike, competition—co-operation, dominance—subordination, identification—counter-identification, and others. Of these the relationships of friendliness and dominance have been selected for study, not because they are considered of greater intrinsic importance for the dynamics or therapeutic efficacy of groups than other interpersonal trends, but because they are accessible to a fair degree of measurement and numerical handling. They can thus render impressions which have been gained through group observation more definite and reliable; they may even correct them or point to aspects which had escaped notice.

The data forming the basis of this study were obtained from a group of nine male out-patients, suffering from social-neurotic symptoms. They were treated by "group-analytical psychotherapy" (Foulkes, 1948), i.e. a method of treatment which leaves the initiative, as far as possible, to the patients, and restricts the role of the therapist to one of guidance and supervision. This essentially permissive and observant attitude of the therapist allows the free and almost undisturbed development of interpersonal relationships.

The patients met twice weekly and the group sessions lasted 1½ hours. The group membership remained unaltered. After 5 months of treatment the patients were given a questionnaire, asking them to record their feelings towards each of the other members, and to judge certain traits and qualities in them.

Likings—Dislikes.

The pattern of friendliness and aversion in groups of people has been extensively investigated by Moreno (1934) and his school who have termed this field of study "sociometrics."

Moreno bases his investigations on a "sociometric test" which consists "in an individual choosing his associates for any group of which he is, or might become, a member."

It was not possible to apply this test as such to the present group. The patients had been selected for treatment because of their neurotic difficulties in company. They had few or no friends, and had anxiously concealed their neurotic symptoms from their social environment. They did not want it broadcast that they had to come for treatment. Therefore, they would hardly have chosen any group member as an associate or friend ; in fact, most of them studiously avoided any contact with each other outside the hospital. They dispersed almost immediately after the sessions and each one chose a separate route home, though joint travelling for at least part of the way would have been possible for several of them. Most of them did not even want to know where other members lived. Indeed, it could be shown that a question concerning the choice of friends among group members would have revealed an inadequate picture of the relations of friendliness in the group. The use of a questionnaire to elicit interpersonal relationships had also other advantages : it facilitated the mathematical analysis of the data and assisted in the assessment of the pattern of dominance.

The questionnaire contained three questions about feelings of friendliness and dislike : (1) Do you like him ? (2) Do you dislike him ? (3) Would you like to have him as a friend ? The answers to these questions could be Yes, No, and Doubtful. Yes was recorded as + 1, No as − 1, and Doubtful as zero. The signs of the scores of Question 2 were reversed so that all questions related to friendliness. The sum of the scores of these three questions are given in Table I, in which the scores of liking which each individual made are entered in horizontal rows. Thus the scores of + 3 in the first row mean that patient A. liked the patients D., F., and I.

TABLE I.—*Friendly Feelings.*

	A.	B.	C.	D.	E.	F.	G.	H.	I.	Friendliness.
A. liking		+1	−1	+3	−1	+3	+1	0	+3	+9
B. ,,	+3		+1	+1	+3	−1	−1	−1	+3	+8
C. ,,	+2	0		−1	−1	+1	+3	+3	+1	+8
D. ,,	+2	0	0		−3	+1	+1	+2	+2	+5
E. ,,	+1	+2	+1	−1		+1	−2	+1	+2	+5
F. ,,	−1	−3	+2	−2	+1		+1	+1	+3	+2
G. ,,	+3	+3	−3	−1	−3	+1		+1	+1	+2
H. ,,	0	−3	−1	+1	−3	0	+1		−2	−7
I. ,,	+2	−3	−3	0	−3	−2	0	−3		−12
Popularity	+12	−3	−4	0	−10	+4	+4	+4	+13	+20

Table I is an asymmetrical matrix with blank diagonal cells. It provides us with four different sets of scores which refer to four separate aspects of the pattern of friendliness in the group. The scores in the cells of the matrix itself represent interpersonal likings ; the marginal column on the right contains scores which denote the different degrees of friendliness which group members felt towards the rest of the group ; the marginal row at the bottom contains scores which indicate the group status of popularity for each of the group members ; the score of + 20 in the bottom right-hand corner is the sum-total of the friendly feelings in the group.

These four aspects of the pattern of friendliness and their significance will be examined in turn.

The general level of friendliness is shown by the sum-total of + 20 of all the scores. Had the interpersonal scores of liking in the cells of the matrix been given purely by chance, this sum-total would have been zero. The greatest possible sum-total for this particular matrix, which was derived from the additive scores of three questions, would be + 216. The actual figure of + 20 is, therefore, very low and indicates a poor atmosphere of friendliness. This agrees with the impression obtained from the observation of the group during sessions. There were only 2 members (B. and E.) who met each other on a social level outside the hospital.

This low level of friendly feelings in the group does not by itself indicate a low degree of group cohesion. If we judge group cohesion by the frequency and regularity of attendance, then the degree of group cohesion was by no means low in this group. It was a " closed " group, and seven of the original nine members still attended faithfully after 10 months of treatment. It seems that the concept of group cohesion should not be too closely linked with the level of group friendliness.

It can be shown that the low level of group friendliness was, for the most part, due to the aversion against choosing a friend among group members. This is revealed by the separate sum-totals of each of the three questions measuring friendly feelings. The sum-total of the scores of Question 1 (" Do you like him ? ") was + 17 ; of Question 2 (" Do you dislike him ? ") + 38 (after reversal of signs) ; but Question 3 (" Would you like to have him as a friend ? ") elicited so many negative replies that the sum-total was − 35. (In spite of the fact that the sum-total of Question 3 differed so markedly from the other two questions, the correlation of the matrix scores of Question 3 with the additive scores of Question 1 and 2 was + ·38, which is apparently significant beyond the 1 per cent. level.)

The figures in the right-hand marginal column of Table I are the sums of the scores of liking recorded by each member. They therefore indicate the total friendliness each member felt for the rest of the group. It will be seen that wide differences existed among the patients. These differences were due to individual and very personal causes which either encouraged or hampered a friendly attitude towards the group as a whole. Patient A., for instance, was an obsessional whose high score of friendliness was the result of reaction formations against his repressed aggressive and critical inclinations. Patient C. was an aloof and unemotional person who had never before experienced the companionable feelings which develop in regularly attended groups. He therefore tended to rate his attitude to the group as friendly, though this was not borne out by his actual behaviour, which was cold and reserved. Patients H. and I. had very low scores of friendliness ; in fact, one should have thought, from their negative scores, that they felt hostile to the group. Yet there was no hostility in their behaviour during group sessions ; it transpired in later group discussions that their negative scores had not been due to a real dislike of the group members, but to a fear of admitting too fond an attitude.

It is interesting that the feelings of friendliness towards the group ran parallel with expectations of being liked. The questionnaire contained two questions concerning such expectations. They were : " Do you think he likes you ? " and " Do you think he dislikes you ? " These two questions taken together yielded scores for the expectation of being liked by the group which correlated + ·84 (which is significant beyond the 1 per cent. level) with the feelings of friendliness towards the group. In other words, the conscious feelings of friendliness towards the group, which each member experienced, were projected on to the other group members.

The differences in individual friendliness towards the group do not tell us much about group phenomena: they merely illustrate discrepant individual standards in the self-assessment of friendly feelings. These differences also obscure the significance of the scores of interpersonal attractions with which we are primarily concerned here. To be able to judge the pattern of friendliness adequately, it is necessary that the scores of friendliness between individuals, i.e. the scores in the cells of the matrix, should be comparable. This is, however, only possible if the total friendliness towards the group is the same for each individual. It is obvious, for instance, that the interpersonal score of + 2, recorded by patient I., whose friendliness towards the group was as low as − 12, had a different significance from that of the same score towards the same patient by patient C., whose friendliness towards the group was + 8.

From all these considerations one must conclude that the raw scores of friendliness as given in Table I require a correction by equalizing the figures of friendliness towards the group as a whole, given in the right-hand marginal column. This would make the interpersonal scores comparable and give a truer picture of the differential likings each patient had for the other members.

Such an equalization can be achieved in various ways; the simplest method is to transform the raw scores of each individual member into rank scores. The person who is most liked by a particular patient will then have the lowest score, i.e. rank 1, and the one liked least the highest, i.e. rank 8. Persons who received equal raw scores will be given "tied" ranks, using the "mid-rank method," which allocates to tied members the average of the ranks they would have possessed if ranked consecutively; e.g. if, in any row, there are two members who have received the highest raw score of + 3, they would each be allotted rank 1·5. The sum of all the rank scores in each row will then be equal to 36 and need not be specially recorded.

TABLE II.—*Friendly Feelings* (*in rank order*).

	A.	B.	C.	D.	E.	F.	G.	H.	I.
A. liking (in rank order) .		4·5	7·5	2	7·5	2	4·5	6	2
B. ,, ,, .	2		4·5	4·5	2	7	7	7	2
C. ,, ,, .	3	6		7·5	7·5	4·5	1·5	1·5	4·5
D. ,, ,, .	2	6·5	6·5		8	4·5	4·5	2	2
E. ,, ,, .	4·5	1·5	4·5	7		4·5	8	4·5	1·5
F. ,, ,, .	6	8	2	7	4		4	4	1
G. ,, ,, .	1·5	1·5	7·5	6	7·5	4		4	4
H. ,, ,, .	3·5	7·5	5	1·5	7·5	3·5	1·5		6
I. ,, ,, .	1	6·5	6·5	2·5	6·5	4	2·5	6·5	
Popularity . . .	23·5	42	44	38	50·5	34	33·5	35·5	23
Popularity (in rank order) .	II	VII	VIII	VI	IX	IV	III	V	I

Table II shows this transformation of the raw scores of liking into rank scores. It can now be seen that the raw score of + 2, given by patient I., meant that he liked patient A. most, whereas patient C., who had given the same score to A., had really ranked him only third.

Sociometrists do not take the variability of personal friendliness and its distorting influence into account. In representing the pattern of attractions in a group they use raw scores and prefer to depict the pattern by means of a sociogram. There is no doubt that a sociogram reveals the criss-cross of the currents of friendship in an easily recognizable form, provided the group is not too large; it does not, however, permit further mathematical analysis of the data. Forsyth and Katz (1946) and Katz (1947) made an attempt to replace sociograms by the use of specially manipulated matrices ("socio-matrix"), but their procedure was criticized by Moreno (1946).

Lazarsfeld (1945) and Bronfenbrenner (1945) have given mathematical formulae which assess the significance of certain sociometric data by their deviation from chance expectancy. These formulae are open to criticism if they are applied to data obtained by means of the sociometric test, but are valid if a questionnaire has been used in the collection of data (Edwards, 1948). It is then, however, necessary to reconsider the probabilities on which the formulae are based.

If we regard as evidence of liking, rank scores between (and including) 1 and 2 in Table II, as evidence of indifference rank scores of more than 2 and less than 7, and as evidence of dislike rank scores between (and including) 7 and 8, we can assess approximately the probabilities of the three emotional attitudes: liking, indifference, and dislike. The probability that person A., if he had filled in the questionnaire quite haphazardly, would have ranked person B. as a liked person is approximately 2 in 8. In other words, the probability of liking (p_1) equals approximately $2/8 = \frac{1}{4}$. The probability of indifference (p_2) equals approximately $4/8 = \frac{1}{2}$, and that of dislike (p_3) equals approximately $2/8 = \frac{1}{4}$. (Note that $p_1 + p_2 + p_3 = 1$).

Of particular interest in the assessment of group structure are those data which indicate the pattern of mutual and non-mutual relationships.

The probabilities of paired choices are given by the expansion of the trinomial $(p_1 + p_2 + p_3)^2$. This expansion contains 6 terms.

Three terms refer to the probabilities of mutual relationships:

The probability of mutual likings $= p_1^2$.
,, ,, ,, indifference $= p_2^2$.
,, ,, ,, dislikes $= p_3^2$.

Three terms refer to the probabilities of non-mutual relationships:

The probability of liking—indifference $= 2p_1p_2$.
,, ,, ,, liking—dislike $= 2p_1p_3$.
,, ,, ,, indifference—dislike $= 2p_2p_3$.

In a group of n members there is a total of $n(n - 1)/2$ possible pairs, i.e. 36 pairs in the present group of nine members. The chance expectancy of paired choices is thus obtained by multiplying each of the above probabilities by 36. (See Table III.)

The derivation of the chance expectancy of non-mutual choices differs from that employed by Lazarsfeld (1945). Lazarsfeld reasoned that an "un-reciprocated choice of A. by B. is to be counted separately from an unreciprocated choice of B. by A." In consequence his formulae make use of twice the number of possible pairs for n persons, and only half the correct values of the probabilities for non-mutual choices.

The values for the chance expectancies have to be compared with the actual frequencies of mutual and non-mutual choices which occurred in the group. Examining the data of Table II we find, for instance, that there were four mutual choices each of liking and of dislike. The four pairs of mutual liking were between the patients A. and D., A. and I., B. and E., and D. and H. Mutual dislike existed between B. and F., B. and H., D. and E., and E. and G.

In larger groups the task of finding, from the matrix scores, the actual frequencies of mutual choices can be made easier by using a method of matrix algebra suggested by Festinger (1949) and elaborated by two of his students, Luce and Perry (1949).

In Table III the values of the chance expectancies and of the actually observed frequencies of the various mutual and non-mutual choices are presented. Both values have to add up to 36, the total number of possible pairs in a group of nine members.

TABLE III.

	Chance expectancy.		Actual frequency.	
Mutual liking	$2\frac{1}{4}$	$13\frac{1}{2}$	4	18
Mutual indifference	9		10	
Mutual dislike	$2\frac{1}{4}$		4	
Liking—Indifference	9	$22\frac{1}{2}$	10	18
Liking—Dislike	$4\frac{1}{2}$		2	
Indifference—Dislike	9		6	
Sum	36		36	

In evaluating Table III we must pay special attention to the pairs of mutual liking, as they represent an index of the established and reciprocated friendships in a group. Bronfenbrenner (1945) called it an "index of coherence." Our task is to assess the significance of the difference between expected and observed values of mutual likings.

The probability how often an observed value of mutual liking could have arisen by chance, is given by the expansion of the binomial $(q_m + p_m)^N$. In this formula p_m is the probability of a mutual choice of liking arising by chance (i.e. in the present case $p_m = p_1^2 = 1/16$); $q_m = 1 - p_m$. N is the total number of possible pairs in a group (i.e. 36 in the present case).

If the observed number of mutual pairs of liking is x, the appropriate term of the binomial expansion is

$$\frac{N!}{x!(N-x)!} q_m^{N-x} p_m^x.$$

The sum of this and of all the subsequent terms of the binomial expansion gives the probability with which x or more pairs of mutual liking could have arisen by chance.

In general, this computation is cumbersome and time-consuming. Bronfenbrenner suggested alternative methods which are more easily calculated, such as approximation by the Poisson Distribution (if p is sufficiently small), by the Incomplete Beta Function, and by Pearson's Type III Function.

In the present example the probability that 4 pairs of mutual liking arose by chance is ·19. This indicates that the difference between expected and observed values is not at all significant.

Table III can also be evaluated in a more general way which takes account of all the paired choices. The three observed values for mutual liking, mutual indifference, and mutual dislike are higher than the values expected by chance alone. To test whether this difference for the 18 pairs of mutual choices is significant statistically, the chi-square technique can be employed. Chi-square is found to be 2·4. The probability of this value (for one degree of freedom) is again not significant.

In this group there was, therefore, neither a significant trend to form pairs of mutual friendships, nor a significant trend to form a distinct pattern of liking and dislike. This result may be partially due to the small number of group members, but it may also indicate that the patients maintained a social and emotional distance from each other which prevented the emergence of a distinct pattern. Such a conclusion would be in keeping with the fact that the group members were socially handicapped by their neuroses and could not readily form interpersonal relationships. A final evaluation is, however, not possible until the results in this group have been compared with those in other groups. It may be of interest in this respect that Bronfenbrenner (1945) compared the frequency of mutual likings in school groups of varying age levels. He found that, with nursery and kindergarten children, the number of mutual likings did not differ significantly from chance expectancy, but that very significant deviations from chance expectancy occurred in older children.

We can now finally turn to the figures in the marginal row of Table II. They are the sums of the ranks of friendliness which each patient received from the rest of the group. They therefore indicate his status in popularity. In the lowest row of Table II the rankings in popularity are given. Patients A. and I. are the most popular members of almost equal status, patient E. is the least popular one.

The rankings of popularity are important data for the study of group dynamics. In assessing the significance of these rankings one has to keep in mind that popularity depends on two complementary factors : (1) the particular group composition and group task, and (2) the personality traits of the patient.

In judging the role which the particular group composition and group task plays in determining the popularity status of a patient, one has to compare his popularity in the therapeutic group with his popularity in other social environments. If his status in the therapeutic group is atypical—if he is either more or less popular then usual—then the explanation must lie in the particular composition and task of the therapeutic group.

If the patient enjoys an unusually high degree of popularity in the therapeutic group, he will naturally derive much narcissistic gratification from his treatment, and may tend to become a " chronic " group patient, who might be profuse in his praise of the treatment and yet show little or no abatement of his neurotic condition. In the opposite case, when a patient is unusually disliked in a therapeutic group, he will probably, sooner or later, leave the group to which he is apparently unsuited.

In other patients the degree of popularity is predominantly determined by personality traits, and especially by those of a neurotic character. A person's status of popularity can be, and often is, a neurotic symptom. In that case, his status will be approximately the same in most of the social groups of which he is a member.

Let us now examine, from these viewpoints, the scale of popularity shown in Table II. This will afford an opportunity to delineate in greater detail the personalities, psychopathology and group responses of some of the patients. It is the particular advantage of group-analytical psychotherapy that it allows not only the examination of group data, but also of the characteristics of individual personalities. To concentrate exclusively on the pattern of interpersonal responses and the scales of group status, produces a mere shadow portrait of group actuality. The description of personalities will add some of the light and life of individuality which is lacking in a purely mathematical analysis.

Patients I. and A. were by far the most popular members, and in either case their degree of popularity had a neurotic aetiology. Patient I., as will be shown later, was the accepted group leader, and his popularity was associated with this fact. As it was his group dominance which was primarily determined by his neurosis, he will be discussed under the heading " Dominance—Subordination."

Patient A. was an anal-erotic personality ; he was meticulous, stubborn, niggardly with money, afraid of dirt, and subject to attacks of indigestion and bouts of vomiting. In the company of his peers he was kindly, obliging and unassuming, hence his popularity in the group and in his office. Hence, also, his high score of friendliness towards the group as a whole, which has been mentioned earlier. Yet his kindliness was a neurotic reaction formation. Generally he disliked and avoided company, as he felt uncomfortable and self-conscious when he was with people who always seemed potentially critical of him.

There were, however, significant loopholes in his unaggressive and accommodating façade. He could be violently offensive when he felt he had the backing of the group or of general opinion. He hated and feared the occasional visitors to the group and was an instigator of subsequent group discussions which expressed group hostility against them. He learned to understand that his antipathy against the foreigner and the Jew had a similar group-supported basis, since without such sanction he would never have dared to feel or express it.

In dealing with people in authority his usual friendly demeanour gave way to an anxiously detached politeness which, however, avoided any sign of deference. He always had to reassure himself that he was not inferior to anybody. He could never call his office superiors " Sir," and he found it nearly impossible to express gratitude to them even if the situation demanded it.

During group sessions he could abreact his hatred of authority without fear of punishment and often with the backing of the group. But such incidents led to discussions which showed up his reaction formations and his anal-erotic characteristics. After months of treatment the group went even further: they linked his mistrust of authority with other psychopathological trends in him, particularly with passive-feminine tendencies and a fear of assuming the masculine role. There was plenty of evidence for this. His nickname as a child had been Cinders, because he loved to do the household chores for his mother; in adolescence he had performed homosexual practices on a grown-up person who rewarded him with presents; in sexual intercourse he had to assume a passive and supine position to obtain gratification; his most disabling symptom, writer's cramp, had started when he signed a Deed completing the purchase of a house which, he felt, saddled him with financial obligations and the responsibilities of a family man.

The two most unpopular members were E. and C. E.'s unpopularity was not due to neurotic traits but to the particular conditions of this group. He was more liked and socially accepted in company which was more congenial to him. His low status of popularity in this group was to a large extent due to his unsuccessful bid for dominance, and will be considered later.

Patient C. was neurotically unpopular in all social situations because of a very marked inhibition of interpersonal emotions. He was cold, aloof, intellectual, and never experienced feelings of genuine friendship or love. His egocentric world was hardly disturbed by the slights and rejections he often encountered. His emotional life was encapsulated in day-dreams and fantasies remote from reality. Whatever personal contacts he had achieved, had been dictated by a spirit of experimentation and curiosity to test his ability of translating some of his fantasies into practice. He had always been lonely, awkward and gawky in company, yet he had become an expert dancer because he desired to meet women and to impress them. Dancing, however, had remained his only sociable asset. It enabled him occasionally to find out how far he could let himself go in making sexual advances. He had no desire for love and friendship, and he did not want sexual intercourse. He was only driven by an anxious feeling of curiosity and bravado. No wonder that his female partners invariably broke off the association after one or two meetings.

His behaviour in the group followed the ingrained pattern. He tried to conceal his emotions and only betrayed them through blushing. When he spoke he was slow, deliberate and intellectual. Often he seemed lost in day-dreams. Another member told him once: "You shut yourself off in your own little world. You always seem miles away from us." There was no warmth of feeling in his relations with any of the other men.

When, at a later stage, three female patients were joined to the group he became more active. He arranged to meet one of them privately. They went out together twice, then the girl refused bluntly to meet him again. Unabashed, he transferred his attentions to another of the female patients. The result was the same. When he showed signs of becoming interested in the third female patient, he caused her such anxiety that she became rudely aggressive and called him a repulsive "gangling idiot," with whom she would not like to be seen outside the hospital.

Naturally, these episodes and rejections formed the topic of discussion during several sessions. His first partner told him : " You seemed completely detached. You were looking for something from me and you were not prepared to give anything of yourself to the relationship. I could not get through to you, and could not get anything from you. It was embarrassing when you took my arm in a more than friendly manner because there was no emotional link between us. You gave me the impression that I, as a person, did not count." Another member : " It seems you were quite egocentric. Were you merely experimenting ? Is it that you want to know how daring you can be ? " On a later occasion he was told that he had been " incessantly prying," that he was like a " Peeping Tom " whose interest was " sheer unadulterated sex." He was left in no doubt about the feelings he had evoked and why. During all these sessions patient C. became the dominant influence in the group and also the most disliked member. The intensity and unanimity of the antagonism he had aroused pierced his armour of unemotional detachment ; he was embarrassed, disturbed and even at times aggressive, but, on the whole, he accepted the volley of abuse and criticism with surprising equanimity.

So far we have dealt with four aspects of group friendliness : (1) the general atmosphere of friendliness, (2) the scale of individual friendliness, (3) the pattern of interpersonal attractions and aversions, and (4) the scale of popularity. By transforming the raw scores of friendly feelings into rank scores the influence of the scale of individual friendliness and of the general atmosphere of friendliness was eliminated. It now remains to consider the relation between the pattern of interpersonal attractions and the scale of popularity.

It would be misleading to assume that a simple additive relation exists between these two group aspects merely because the scale of popularity was derived from summing the interpersonal scores of liking which members received from the rest of the group. In fact, the same scale of popularity would have been obtained from a multitude of different patterns of interpersonal attractions.

Furthermore, the two group aspects are different in quality. The scores of interpersonal likings are based on the *subjective* self-assessment of friendly feelings ; the scale of popularity, on the other hand, must be considered as an *objective* group characteristic. The terms " subjective " and " objective " are here used in the sense indicated by Karl Jaspers (1948), that subjective facts are " immediately experienced by the patient and only indirectly accessible to the observer," and objective facts are " perceivable in the world and directly demonstrable." The objectivity of the scale of popularity could be definitely established if a number of independent and emotionally detached observers of group events would arrive at scales of popularity which differed little from each other.

In the present example no group observers were present, and the objectivity of the scale of popularity is therefore only an assumption which, I submit, can be justifiably made.

It may then be asked : How far were the group members aware of the scale of popularity, and in what way, if at all, were they influenced by it ?

First of all : Were the group members aware of their own status of popularity ? The answer to this question can be given, and it is " No." The rank correlation coefficient between the expectation of being liked and the scale of popularity, as revealed in Table II, is —·23 which is far from significant.

Were the group members aware of the scale of popularity excluding their own status? This question cannot be answered with confidence, as the desirability of such an enquiry had been overlooked when the questionnaire was drawn up.

It is, however, likely that the members had some impression of the scale of popularity as far as it concerned the rest of the group. If so, did this knowledge influence some or all of the friendship scores they recorded? The answer to this question is again uncertain; yet it would be of practical importance to know what kinds of questions are most likely to reveal subjective feelings undistorted by the influence of objective popularity. It would, for instance, be of interest to ascertain whether more reliable scores are obtained by the questionnaire method used here or by requesting the patients to rank their friendly feelings towards the other members—a method which would be closer to the sociometric test.

In the present investigation this direct ranking method has also been used in order to check the reliability of the scores of friendliness obtained by means of the questionnaire. After the patients had completed the questionnaire they were required to group the other members in order of liking and to indicate those patients about whose ranking they felt uncertain. These uncertain scores were regarded as tied rankings. It was found that the scale of popularity derived in this way had a rank correlation of + ·95 with the scale of popularity shown in Table II.

There were minor differences among the interpersonal scores in the cells of this new matrix, and some of these differences seemed to indicate an awareness of the objective scale as cause. This was particularly the case with the scores which the most popular member, I., received. When the other patients directly ranked their feelings of friendliness towards him, four of them accorded him a higher status of popularity and only one a slightly diminished status, as compared with the figures obtained in Table II.

There was possibly another effect of the same kind. The mutual friendship between patients B. and E. was beyond doubt, as they were the only two members who met on a social footing outside the regular group meetings. Table II recorded this mutual friendship, but the new matrix did not. Both these patients had a low status of popularity and it is feasible that this fact was responsible for the reduction of their interpersonal rank scores, so that they appeared to be mutually indifferent in the new matrix.

It would be rash to place too much weight on these findings. The fact that the questionnaire method yielded apparently more adequate results in the present case may have been a chance product. It is advisable, however, to keep the possibility in mind in future investigations, that the subjective scores of friendliness may be distorted by the influence of the objective scale of popularity.

DOMINANCE—SUBORDINATION.

It is a general characteristic of established groups that a hierarchy of dominance emerges among their members. Such hierarchies have been observed in many types of animal groups (e.g. Maslow, 1936, and Masserman, 1943). The present author has previously reported on some aspects of dominant personalities in therapeutic groups (F. Kräupl, 1947). It appeared that the status of dominance was not decided by personal aspirations, but by objective personality traits and their adequacy for the group task.

To obtain a measurement of the hierarchy of dominance in the group a different approach had to be chosen from the one that had proved useful in arriving at the scale of popularity. It was not attempted to ask the members whether they *felt* dominant to another patient as it was thought that the patients would have produced scores so biased and distorted by egocentric influences as to be of poor validity.

The following method was therefore adopted. As the scale of dominance is an objective scale, like the scale of popularity, it could be assumed that the group members would have a general impression of its distribution, and that their impression would come as near to an objective measurement as had been the case with regard to popularity. The members were therefore asked to give the names of those patients who had dominated and influenced the group discussions most and least, irrespective of whether such influence had been regarded by them as helpful or not. The replies to this question yielded a provisional scale of dominance. To improve its validity it was necessary to find questions tapping dominant attributes in a more indirect way. To avoid selecting such questions on *a priori* grounds, correlations between the provisional scale of dominance and corresponding scales derived from other questions in the questionnaire were calculated. As the sample size was only nine, the correlation coefficients (for 7 degrees of freedom) had to be ±·67 or more, to be significant at the 5 per cent. level at least. In this way it was found that the provisional scale of dominance seemed to be significantly correlated with questions referring to forcefulness, courage, self-confidence, verbal facility, ready admission of embarrassing personal data, lack of feminine trends, and postulated leader capacity in an emergency. Assuming that these questions assessed various aspects of dominance, the individual scores of all these questions were added together (as had been done with the scores referring to friendly feelings). The final scores of the judgments of each individual patient were then transformed into rank scores, and a matrix of dominance judgments was thus obtained (Table IV.).

Table IV.—*Hierarchy of Dominance.*

	A.	B.	C.	D.	E.	F.	G.	H.	I.
A. judging (in rank order) .		4	5·5	5·5	2·5	7	2·5	8	1
B. ,, ,, .	4		5·5	7	2	5·5	3	8	1
C. ,, ,, .	6	7·5		7·5	3	5	2	4	1
D. ,, ,, .	3·5	8	3·5		6	5	2	7	1
E. ,, ,, .	2	8	4	5·5		7	3	5·5	1
F. ,, ,, .	5·5	7·5	3·5	5·5	2		3·5	7·5	1
G. ,, ,, .	3	7·5	2	5	1	7·5		4	6
H. ,, ,, .	6	8	4	5	2·5	7	1		2·5
I. ,, ,, .	3	4	5	6	1	7	2	8	
Dominance status . .	33	54·5	33	47	20	51	19	52	14·5
Dominance status (in rank order)	IVss	IX	IVss	VI	III	VII	II	VIII	I

The scores of dominance judgments in Table IV have an essentially different meaning from the scores of feelings of friendliness in Table II. The scores of friendliness registered subjective feelings towards others, and these feelings could be mutual or not. The scores of dominance, on the other hand, are based on judgments of objective personality traits in others, and are only indirectly affected by subjective feelings. The question of mutuality does not arise with them. The data of special interest are: (1) the distribution of the scores which each member received from the rest of the group (i.e. the distribution of the scores in each column), and (2) the distribution of the total scores for each member (i.e. the sums of the columns) which corresponds to a scale of dominance.

If the questions which were selected from the questionnaire consistently measure aspects of dominance, and if the judgments of the individual members were, as far as possible, objective and undistorted by personal bias, the scores in each column should be fairly consistent and show little variation. Examining the columns of Table IV from this point of view, we find that the patients D., F. and G. have been judged consistently, and that almost all the other patients received fairly consistent scores, if one or two exceptions are ignored in each case. In fact, almost all these exceptions could be explained by personal bias on the part of the judging member. We may therefore accept Table IV as an approximate and fairly objective record of the distribution of dominant traits among the group members.

The scale of dominance is expressed in rank order in the bottom row of Table IV. It will be noticed that I. was the most dominant member. As he had also been first on the scale of popularity, patient I. is revealed as the accepted leader of the group.

E. and G. came next in dominance. It is an interesting and obviously significant fact that these two patients were the only members of the group who interrupted their treatment prematurely; the other seven members continued to attend regularly until their treatment was terminated after nearly two years. I must, however, confess that it was only in retrospect when studying the scores of dominance, that I was duly impressed by the implications of this fact.

Patient E., in spite of his high status of dominance, was the least popular group member. (It is, therefore, not justified to speak of the most popular member in a group as the "leader," as sociometrists generally do. Dominance and popularity need not go together. In fact, there was no significant correlation in the present instance between the scale of dominance and popularity). It has already been mentioned that the unpopularity of patient E. was due to the particular circumstances of this group. These circumstances were the rejection by the group of his bid for dominance. He had a slight stammer, but was a verbose speaker who could not express himself clearly and concisely. This often exasperated the group. They were also annoyed by E.'s frequent and ostentatious announcements that his neurotic symptoms were rapidly disappearing. I shared the group's doubt of the genuineness of this professed improvement. However, E. decided, after about eight months of treatment, that he was as well as he could hope to be. He applied for a job in a distant town and was accepted. This made any further group attendance impossible. A year later he informed his group friend, patient B., that his improvement had continued and that he was confident that his neurotic difficulties would not return.

While patient E. thus interrupted his group treatment prematurely because he felt he was more or less cured, patient G. gave his reasons for leaving the group that he had derived no benefit from it, and that he could not hope to achieve any improvement as all the group members were hostile to him. This second reason was by no means correct, as G. occupied the third rank in popularity, as shown in Table II. During group sessions it was noticeable that G. endeavoured to oust I. from his leading position. He was aggressively contemptuous of I., and started heated arguments with him at almost every meeting. This antagonism is also reflected in the scores of Table IV. Whereas almost all the members had ranked patient I. as highest in dominance, G. had relegated him to the sixth place. This explains the one inconsistent score in I.'s column in Table IV. There were other reasons for G.'s decision to discontinue treatment, but his frustrated aspiration for dominance certainly played an important, though at the time insufficiently realized, role in it.

Patients B. and H. occupied the lowest positions on the scale of dominance. These two patients, though they disliked and avoided each other, had one symptom in common which separated them from the rest of the group: they had marked homosexual tendencies. The low dominance rating they received was, in part, determined by the antagonism, fear and contempt the spectre of homosexuality had aroused in the other patients. This applies particularly to patient B. In fact, it seems that B.'s subordinate status in this group was due mainly to this group bias, and not to marked submissive traits in his personality. B. achieved a more dominant status in other social situations, and particularly when he felt he was not suspected of homosexuality. His occupation was that of a salesman, and he was fairly successful in it, which would have been impossible if he had really been a very passive and submissive person. When B. became a member of a sexually mixed group, together with H. and D., he actually achieved a fairly high position of dominance, of which more will be said presently.

Patient H., who shared homosexual inclinations with B., was truly and neurotically subordinate. He felt so anxious when he was in the company of more than one other person that he could not assert himself in any way. Later, in the mixed group, he became almost completely silent and could only be induced to speak a few whispered words with obvious distress. He soon became almost totally neglected, but he continued to attend the group sessions until they came to an end.

Social fears, which thus effectively and disastrously inhibited patient H., had an entirely opposite effect on the group leader, I. This patient was impelled by his social neurosis to strive for dominance and mastery. Superficially he gave the impression of being a sociable person who enjoyed company and conversation. Yet this apparent sociability concealed neurotic handicaps of such severity that they would have been crippling to another person with a less resourceful and successful defence against them. His leading symptom was a fear of blushing, and his whole life had become a constant manoeuvre to avoid any situation in which his blushing might be observed. He could not work in an office or eat in a restaurant. On buses he felt uncomfortable unless he could hide himself behind a newspaper. He could not even pass a cinema queue without acute embarrassment. Yet his occupation—he held a good position as an engineer—was so carefully selected and his work so ingeniously arranged that he succeeded in avoiding all compromising situations. Nobody ever suspected that he was suffering from neurotic social fears, not even his wife. But eventually he had to confess to her that his refusal to go with her to dances or on visits to friends was not due to ill-will or neglect, but to anxieties he could not overcome. It was only after this confession to his wife, and on her initiative, that he came for treatment.

In the group, as in all other company, he made sure that he had a place with his back to the light so that the colour of his face could not be easily observed. He could not leave the conversation to others, but had to monopolise it. Otherwise he felt trapped and could not banish the fear of blushing from his mind. At the beginning of group treatment he kept up an almost continuous flow of conversation, and, although this anxious compulsion to speak at all costs soon abated, he remained, during the whole course of treatment, one of the most vocal members. It was characteristic of him to make impetuous peremptory statements whenever the trend of the discussion embarrassed him. The first time he replied to an awkward question: "I must think first," he was congratulated by the group on showing so much improvement. He remained the most dominant member, except for brief periods, but his manner became more restrained and considerate. Towards the end of group treatment, when he was reminded of his previous behaviour, he exclaimed: "I can see now what a bumptious bore I must have been."

The scores indicating the scale of dominance in Table IV show that patient I.'s leader position was very secure, especially after his two rivals (E. and G.) had left the group. I.'s score was 14·5 and the score of A. and C., who tied for the next rank, was only 33. The scores of the remaining members ranged from 47 to 54·5. This distribution of scores reveals that the group consisted of one active leading person (patient I.), two members (patients A. and C.) who were co-operative, but reluctant to take the initiative, and four members (B., D., F., and H.) who were in very subordinate positions. The result was that, whenever the group leader I. was absent, the conversation tended to flag.

This situation remained unchanged as long as the group membership was the same. After 10 months of treatment, two sexually mixed groups were formed by amalgamating the members of this male group with those of a female one. Some of the results of this amalgamation have been reported elsewhere by the author (1949). The change in group composition was accompanied by certain changes in the hierarchy of dominance. Patient I. retained his position, by and large, but patient C. gained in dominance and, for a time, even surpassed I.'s influence. This happened during C.'s unsuccessful attempts to form friendships with female members.

The second mixed group contained three men and four women. All the men (B., D., and H.) had been of subordinate status in the all-male group.

In the new group the two dominant positions were held by female members. Patient B., who had been the most subordinate member in the all-male group, mainly because of his homosexuality, felt less inhibited in feminine company, and gained in influence and group co-operation to such an extent that he now occupied the third position of dominance. He also surpassed the other two men in popularity. His rival, H. (there had been mutual hostility between H. and B.), accepted his defeat and sank to a very insignificant position. D., on the other hand, responded with an effort of aggressive self-assertion, which was quite unusual for him, in order to re-establish his dominance over B.

D. was the most gifted and intelligent of all the group members. His scores on the General Aptitude Test Battery (U.S. Employment Service) were consistently high. His (corrected) score for general intelligence was 138, and his (corrected) verbal score was 154. Yet these assets were of little avail to him in the group or in life generally. His neurotic handicaps were very disabling. When he joined the group his occupation was that of an unskilled labourer. He had persuaded himself that he had no social ambitions and did not want to live by " bourgeois " standards. He soon realized, however, the " sour-grapes " basis for these rationalizations, and was then able to improve his vocational position to a certain degree.

He was very inhibited during group sessions. Any form of potential domination and criticism generally silenced him. If he wanted to speak in the group, he had to make determined efforts to overcome his trepidation. After sessions of the all-male group, however, he would collect around himself those few patients who were of lower dominance status, and hold forth to them, displaying his superior knowledge gained by wide and voracious reading.

D.'s aggressive attempt to regain his dominance over B. occurred after the mixed group had been established for nine months. A direct and undisguised battle for dominance in a long-established group of constant membership is not often observed, and it is proposed to give an account of it by quoting verbatim extracts from group records. Only the three main protagonists will be mentioned, and they will be referred to as Eve (the dominant female member), Bill (patient B.), and Don (patient D.).

The events were foreshadowed in a session in which Don complained that his symptoms prevented him from achieving any of his ambitions. " There is a world of difference," he said, " between my ambitions in fantasy and in reality. . . . A little learning is an ambition of mine, but it is so undermined by symptoms. It is really quite hopeless. My learning capacity operates only at 5 per cent. efficiency."

At the next session Don opened his attack on Bill quite unexpectedly and without provocation. Bill had remarked that he had been quite successful as a salesman and had acquired a fairly good working knowledge of wireless and television.

Don (to Bill) : " Do you think you know more about salesmanship and wireless than I do ? "

Bill (apologetically) : " I would not say so."

Eve came to Bill's support. She turned aggressively to Don : " Why do you think you know more than Bill ? Are you perhaps an engineer ? "

Don : " I am not an engineer, but I am fully qualified in all branches of wireless and radar. I learned it in the Navy."

Eve : " You still can't say you are better than Bill unless you go and compare your knowledge with his. Anyway, Bill is not an engineer. He is a salesman and he has been quite successful."

Don : " Do you think he knows more about salesmanship than I do ? "

Eve : " *Do* you know anything about it ? "

Don : " I do."

Eve : " Then why do you stick to your inferior office job ? "

Don (disregarding the question) : " I used to do some selling myself for a short time."

Bill : " I have had quite a long experience. I stood behind a shop counter in the West End for five years."

Don : " From what I have seen of people behind shop counters I have come to the conclusion that they have no knowledge of salemanship at all. . . ."

Bill : " You could not work behind a counter. You could not come down to the level of the shopper."

Don : " I would not want to do that. I don't want to be good at my office work either. . . ."

During the next session Don resumed the attack. Eve had mentioned that her sister was working in a factory although she should have a better job, as she was very intelligent.

Don (to Eve) : " This calls out my iconoclastic tendencies. Do you think you are much above average intelligence yourself ? "

Eve : " No, but my sister is more intelligent and yet she just sits there in that factory."

Don : " Intelligent people do such things. Perhaps she considers ambitions as puny. My ambitions are far above average jobs. So far above, that I could not even attempt them. Symptoms would prevent me from trying, anyway." Shortly afterwards he revived the previous argument concerning Bill's ability as a salesman. Bill had once failed in a course of salesmanship, and Don now reminded him of it. Surely that was proof that Bill was not a good salesman.

Bill : " I did that course before I started treatment. I felt very inferior then. Now this fear of inferiority has gone. I feel that I have a brain as good as anybody else. And I am not afraid of speaking up as you are."

Don : " I thought you failed through your lack of education. This lack of education has not been changed through group treatment. You are not being educated by the group here."

Bill : " I think this measuring of intelligence is quite a thing with you. You always try to compare your own intelligence with that of other people, and you are not satisfied until you find that you have more."

Eve : " He probably has."

Don (to Bill) : " These ridiculous sweeping statements annoy me. You say you have as much intelligence as anybody. What do you mean by that ? I have met a lot of dull people, but I have never yet met one who does not think he is intelligent."

Eve : " Perhaps you can tell us what intelligence is ? "

Don : " That is difficult to say. All the authorities are at loggerheads about the definition of intelligence." He started to give a lecture on the meaning of intelligence, and I had to interrupt him pointing out that some of the other members had difficulties in following his academic discourse.

The group agreed with me and someone remarked that Don often used difficult words whose meaning could not be easily understood.

Don : " It is never easy to give the meaning of words. There are lots of words that have as many as five meanings. But you can always estimate the meaning of a word from the context. One can have a verbal ability without knowing the exact meaning of words. Verbal ability is often related to general intelligence. I suffer from a lack of verbal facility in practice. I can never get the word I want."

Eve (sarcastically) : " You have so many to choose from."

Don : " No. My verbal facility must be bad because I have to look up words. Verbal facility means that the words come natural in speech. When I am reading and I come across a word that has several meanings, and I only know, say, three of them and not more, I have to look it up. I appear to be exhibitionistic with words, but I don't think I am. I could have learned a lot of easy words with one simple sense only, but it is euphuistic words which sound well that I am after." (He made a slip here. He wanted to say euphonic, but euphuistic is unwittingly correct, as it means an artificial and affected style.) " But one can use a lot of skill with words without demonstrating it. With a symptom like mine there is no possibility of enjoying books. If you have to check punctuation and the sense of the words, it kills any pleasure. . . ."

At the next meeting Don arrived even later than usual. (Coming late was an obsessional symptom with him.) He was reticent through most of the session except for some sarcastic comments which were disregarded by the group. Towards the end of the session he again made some very offensive remarks to Bill. When the meeting ended I asked Don to consider why he should feel so hostile towards Bill. Was he perhaps envious of Bill? Why did he have to emphasize his own superior intelligence? I also made a remark about social intelligence which was unfortunate as it provoked Don.

When the group met again, Don remained stubbornly silent and refused to answer any questions directed at him. Eventually a pause in the conversation occurred. Don fumbled for a cigarette and began to smoke. (This was usually the signal that he would make an effort to speak.) He began to talk very rapidly: "Dr. Taylor mentioned social intelligence last time. I have looked it up. Thorndike's ideas about social intelligence happened about 20 years ago. They were never verified. He has now capitulated to the Spearman School. Spearman's ideas about general intelligence and a factor *g* are now generally accepted. It is now used by Professor Burt to make certain predictions about the decline of general intelligence in this country." He stopped, opened a book he had brought along, and began to read very quickly a passage from a chapter on general trends in psychology. The other members were half amused and half astonished. They did not understand a word of Don's rapid and erudite talk. I interrupted Don to point this out. I also apologized for using the term social intelligence, which had such a doubtful meaning.

Don: "I don't believe in social intelligence—or verbal intelligence."

Eve: "What do you believe in?"

Don: "Spearman's *g*-factor. I find that in practice it is amazing how accurate it works out. Judging from a man's intelligence one can make a shrewd guess of a person's gullibility or perspicacity. The doctor says we should not discuss intelligence theoretically, but I don't think I ever raised the point of intelligence."

Eve: "Yes you did—and you could never leave it. Incidentally, what is your I.Q.? I would be interested."

Don (evasively): "I don't know. Doctor knows. In any case, one can make observations of fact without measuring them. I could have an I.Q. of 80 and still pay homage to Spearman's *g*."

I asked him why he was so annoyed with me.

Don: "This business of social intelligence irritates me. It is a capitalist ideology. It is like the term 'business ability.' I can't bear it. That thing isn't true. I know that business shrewdness, where it exists, depends greatly on innate intelligence. But I don't think that Bill is a better salesman than I am. I think he is gullible."

Another argument developed, which Eve tried to end in a conciliatory way. She told Don that it was a pity he could not make better use of his great intellectual gifts. He might be happier if he could make some contribution to society. Don grew sad and reflective. He remarked that he could never be happy in any society. He had been happy in childhood, at least with his mother. His father had always been a drunken tyrant, but he was only rarely at home. When his mother deserted the family to live with another man, Don had lost all ability for happiness. He ended: 'I can understand Fascist and Communist attitudes—the desire to smash everything. Where there is no inner peace you can give yourself up to any revolutionary idea."

The skirmishes between Don, Bill and Eve continued for a number of sessions. Don forced the group to take notice of him, to refer to him, to listen to his interpretations and explanations. It seemed, for a short while, that he might establish himself as one of the most dominant group members. But when he had gained his point of subordinating Bill, the vigour of his aggressive bid for dominance waned. His neurotic fears prevented him from maintaining the influence on group proceedings which he had achieved during his attack on Bill.

In the present investigation attention has been concentrated on the pattern of friendliness and the hierarchy of dominance. These group structures appear to be fairly stable and enduring as long as the group composition remains unaltered. Minor variations and fluctuations do, however, occur according to the changing mood of the group, the topics under discussion, and differences in individual group response and development. These variations cannot be elicited by means of a questionnaire, but they are revealed through group observation. In a fuller assessment of the social interactions in groups it will also be necessary to take account of other interpersonal trends and their concerted effects on group proceedings.

SUMMARY.

A therapeutic group of nine male out-patients has been investigated by means of a questionnaire in order to elicit the pattern of friendliness and the hierarchy of dominance.

A mathematical and clinical analysis of the data has been carried out.

The relationship between the status of popularity or dominance and individual or group characteristics has been discussed.

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BODY BUILD, PERSONALITY AND NEUROSIS IN WOMEN.

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Introduction.

The theory that physique and temperament are correlated remains a subject of controversy. Various workers in the field differ in their findings and, in the past, investigations on body build and its psychological correlates have been handicapped by lack of precise knowledge of the variations in body build. In recent years improved statistical methods of analysis have been applied to the study of body build, enabling the variations in physique to be analysed and assessed inductively.

This paper describes an investigation into the alleged association between body build and temperament in women utilizing a new body-build index, consisting of a regression equation of four measurements derived from the results of a factorial analysis of female body build (Rees, 1950).

Historical Survey.

The notion that physical features provide clues to mental and moral qualities is very ancient and may be found in the literature of all ages. An old Greek proverb states, " A gross belly does not produce a refined mind," and in Shakespeare's "Love's Labour's Lost" (Act i, Sc. 1, line 26) is stated, "Fat paunches have lean pates ; and dainty bits make rich the ribs but bankrupt quite the wits." A clear affinity between body type and temperament is indicated by Caesar's well-known remarks to Anthony ("Julius Caesar," Act i, Sc. 2, line 92):

> " Let me have men about me that are fat, sleek headed men and such as sleep o' nights. Yond Cassius hath a lean and hungry look. He thinks too much : such men are dangerous. Would he were fatter! But I fear him not. Yet if my name were liable to fear, I do not know the man I should avoid so soon as that spare Cassius."

From ancient times we find two parallel and distinct lines of thought regarding physical and temperamental correlation. On the one hand we have the science of physiognomy founded by Aristotle (384–322 B.C.). Aristotle's views were published in his book *Physiognomica*, and his work was continued in the third century in Greece by Polemonis, and in the fourth century by a Jewish physician, Adamantius.

Physiognomy was expanded by speculation to a rather ludicrous degree in a book by Lavater in 1841. Physiognomy was also at this time deflected into the later discredited science of phrenology by Coombe, Gall and Spurzheim, and later in the nineteenth century by Lombroso into the now invalidated science of criminal anthropology.

Parallel in development to the study of physiognomy we have the theory of temperaments. Hippocrates (460–375 B.C.) considered health to be due to the optimum mixture of four humours and disease a disturbance of this relationship. The humours were blood, phlegm, black and yellow bile, corresponding to the four primary elements—air, water, earth and fire—from which all substances were thought to be constituted. Galen (A.D. 129–199) described nine temperamental types allegedly attributable to various humoral admixtures and with characteristic physical attributes. The Galenic theory not only attempted to explain temperamental differences, but was also a general theory of disease causation, and as such dominated medical thought as late as the eighteenth century.

No serious attempt was made to study the importance of physical constitution in mental disease until the early nineteenth century, when Esquirol (1816) found that the strong robust type of physique was associated with an acute course of psychosis with crises, whereas the lymphatic type of physique tended to be associated with a more chronic dementing course of psychosis. These remarkable observations antedated Kretschmer's (1921) work by over a century. The Kretschmerian theory of a biological affinity between asthenic, athletic and certain dysplastic physiques and schizophrenia on the one hand, and between pyknic physique with manic-depressive psychosis on the other, provided the main stimulus to modern research into physical constitution in psychiatry and psychology.

Kretschmer's work has been criticized on grounds of methodology, mainly on account of its subjectivity and lack of anthropometric and statistical validation. The following investigations support Kretschmer's theory in the main: Weissenfeld (1925), Olivier (1922), Rohden (1926), Shaw (1925), Wertheimer and Hesketh (1926), Farr (1928), Cohen (1940), Betz (1942), Rees (1943). The following support the theory in part: Clegg (1935), Burchard (1936), and the following workers give no support to the theory: Mollenhoff (1924), Kolle (1925), Garvey (1930), Wells (1938), Farber (1938).

Similarly the extension of Kretschmer's body type theory from psychotic types to include normal personality types (schizothymic and cyclothymic) stimulated a considerable research on the psychological correlates of physique.

Marked differences in psychological traits between pyknics and leptosomes have been reported by Kibler, Van der Horst, Enke and others (Farber, 1938). Pyknics were found to excel in incidental memory and to have a greater perception span. In the tachistoscopic perception of a long work leptosomes were found to use an analytic atomistic method, while pyknics perceived first the "Gestalt" and then the details. Pyknics were superior in perceiving colour and leptosomes in perceiving form.

Some workers, e.g. Pillsbury (1939) and Kraines (1938), found no evidence to support Kretschmer's theory in the correlation between introversion and extraversion and physique as measured by body-build indices. Sheldon (1942), in his book *Varieties of Human Temperament*, described three primary components of personality designated Viscerotonia, Somatotonia and Cerebrotonia,

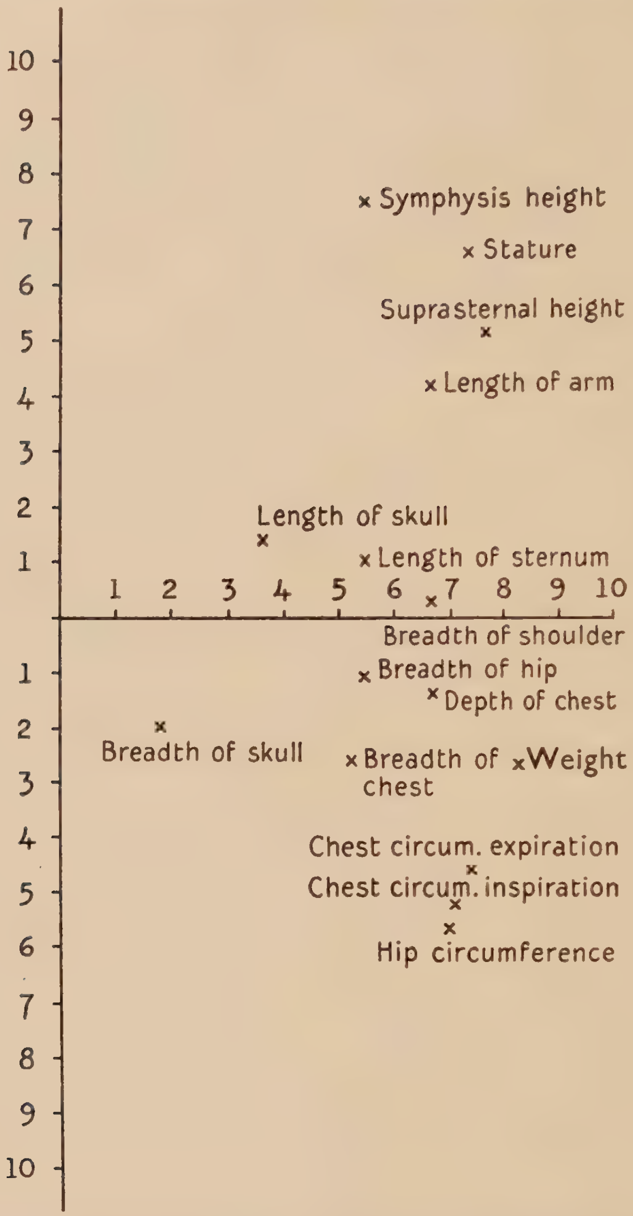

FIG. 1.—Saturation of anthropometric measurements with general and type factors.

which correlated very highly with the three primary components of physique described by Sheldon (1940), viz., Ectomorphy, Mesomorphy and Endomorphy, relating to the degree of development of structures of three primary germinal layers, ectoderm, mesoderm and endoderm.

Although physique and temperament has been the subject of considerable research, the question of relationship between physical constitution and neurosis has received little attention. Naccarati (1934), using an index based on that of Viola, classified a group of 100 male neurotics into microsplanchnic, normosplanchnic and macrosplanchnic types. He found the group had a larger number of extremes of physique than the normal population, and that the so-called emotional neuroses, in which he includes anxiety states and hysteria, were associated with macrosplanchnics, whereas neurasthenic patients were more microsplanchnic than the normal and emotional neurosis groups. Unfortunately Naccarati's work is vitiated by absence of statistical validation, by his classification of neurosis, and because the criteria used in diagnosis are not given, and therefore one cannot be sure what neurotic syndromes are included under particular diagnostic terms, e.g., neurasthenia.

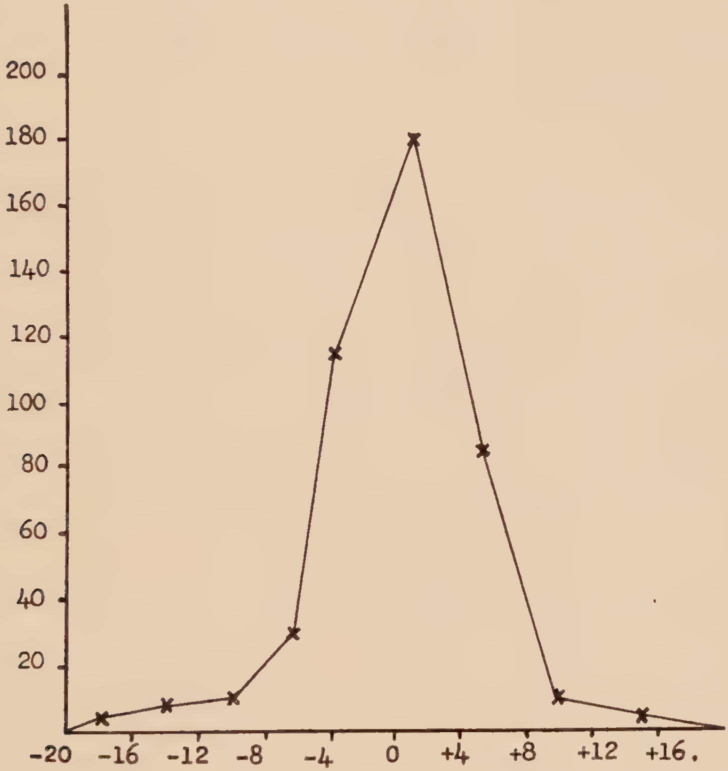

FIG. 2.—Frequency distribution curve of a new index of body build in a group of 400 women.

Burt (1937) found that in children stoutness was correlated positively, but to a very small extent, with cheerful emotions, whereas relative thinness correlated with inhibitive and repressive tendencies. He concluded that no definite associations were found as the correlation was seldom above ·15. In adults he found that the asthenic build was associated with repressed and introverted temperaments and tendency to depression. He found that much of the correlation was attributable to the fact that the group contained several who showed mild hyperthyroid symptoms and a number who were definitely ill nourished. His final conclusion was that the measurable correlations between physical and mental characteristics, though frequently positive, were almost always too small to be treated for the needs of diagnosis.

Sanford (1943) and his co-workers at Harvard have published an interesting study of physical and psychological correlates in normal children. Using factorial methods to analyse the intercorrelations of 18 anthropometric measurements similar to those used in this study, they elicited the existence of two contrasting body types, the tall-narrow and the wide-heavy. The tall-narrow type was found to be associated with autonomic dysfunction, good intelligence test results, satisfactory school progress, and with guilt feelings, remorse and other features similar to a dysthmic category described later. Wide-heavy body build correlates negatively with autonomic dysfunction, social feeling and lively self-expression.

RESULTS.

The experimental population consists of 400 women service patients suffering from neurosis successively admitted to Mill Hill Emergency Hospital. Using the new regression equation index of body build, the group was classified according to the criteria described by Rees (1950) into 60 leptomorphs, 263 mesomorphs and 77 eurymorphs. An item sheet containing some 200 items relating to personality and neurosis was analysed for the three groups, the distribution of items expressed in percentages and compared by means of the critical ratio. A summary of the results is given in Table I. Items marked with one cross (+) are suggestive with a critical ratio somewhat less than 2; items marked with two crosses (++) are significant with a C.R. between 2 and 3; items marked with three crosses (+++) are very significant with a C.R. of over 3.

The items are arranged in groups. The first group deals with age distribution. It will be seen that there is no marked trend of association between body build and age group.

The second group contains hysterical and dysthymic traits. These traits were particularly chosen because factorial analysis of neurotic symptoms had shown a tendency to a dichotomy of clinical types into hysteria and dysthmia (Eysenck, 1944). It will be seen that the eurymorph group tends towards hysterical traits and symptoms, whereas leptomorphs tend more towards dysthmic symptoms and traits.

The next group contains personality items relating to the introversion-extraversion dichotomy of Jung and the schizothymic-cyclothymic dichotomy of Kretschmer (1934). It will be seen that leptomorphs show a greater tendency to introversion or schizothymic tendencies, whereas eurymorphs tend to be more extraverted or cyclothymic.

The fourth group relates to manifestations of autonomic dysfunction. It will be seen that leptomorphs show a higher incidence of manifestations of autonomic dysfunction than do eurymorphs.

The last group contains miscellaneous items of interest. It will be noted that leptomorphs have a higher incidence of well-marked neurotic disorder in the family and of childhood neurotic symptoms. These features are two of the more important indicators of the neurotic constitution according to Slater (1943). This indication of a greater degree of neurotic constitution may also possibly be related to the higher proportion of cases with an illness of over

TABLE I.

	Leptomorph (60).	Mesomorph (263).	Eurymorph (77).	Standard of significance.
1. *Age:*				
16–20	12·2	17·5	20·2	..
21–25	61·1	51·2	45·9	..
26–30	10·7	19·6	24·3	..
31–40	7·7	9·8	8·1	..
41–	2·2	1·7	1·3	..
2. *Hysteria versus Dysthmia:*				
Hysterical personality	14·4	23·9	20·2	..
Very marked hysterical traits	2	5	8	+
Hysterical, motor and sensory conversion symptoms	12	14	23	+
Headache	61	69	69	..
Anxiety, moderate and severe	71	55	49	+++
Depression, moderate and severe	52	41	33	++
Irritability	54	44	37	++
Diagnosis: Anxiety state, acute, severe	14	10	8	..
Diagnosis: Anxiety state (all types)	60	59	51·3	..
3. *Personality:*				
Marked schizoid personality	6·7	7	2·7	..
Very touchy and suspicious	7	6	1·5	..
Weak, dependent	89	55	46	+++
Narrow interests	63	52	54	+
Inert, apathetic	15	6	9	..
Markedly cyclothymic	2·2	7	8·1	..
Hypochondriasis	37	27	25	+
4. *Autonomic Dysfunction:*				
Autonomic symptoms (palpitations, sweating, etc.)	49	44	40	..
Effort intolerance	65	62	55	..
5. *Miscellaneous:*				
Duration of illness more than 1 year	40	45	27	..
Positive family history of marked neurosis	30	33	21	..
Childhood neurotic symptoms	48	43	42	..
Backward in elementary school	5	6	13	..
Good past physical health	57·7	71·7	22·9	++
Vocabulary test above average	22	22	14	..
Matrices test above average	13	10	12	..

one year's duration in the leptomorph group. Eurymorphs show a higher incidence of patients with poor scholastic record, i.e., did not pass Standard V in elementary school. It is interesting to note that Eysenck (1944) finds that this is correlated with hysteria. It will also be seen that eurymorphs have a lower incidence of patients who are above average in vocabulary score, whereas on the matrices test, which is non-verbal, there is practically no difference. In this connection it is noteworthy that Eysenck, Himmelweit and Rees (1947) have shown that the vocabulary level of the hysteric is significantly worse than the dysthymic of similar intelligence level.

An interesting finding is that both eurymorphs and leptomorphs, particularly the former, have a poorer past history of physical health than the mesomorphs. This confirms Pearl's (1933) finding that individuals of intermediate physique had a lower incidence of physical ill-health than the extreme types.

Discussion and Conclusions.

The results of our investigation on the relationship between female body build as measured by a new index and psychological features conform to the same pattern as those found in the study of male neurotics (Rees and Eysenck, 1945), although the differences between the extreme types in women are not as marked. The correspondence of the results in adult groups of each sex with those of Sanford (1943) in children is striking. The association of eurymorphic body build in adult groups of both sexes with hysterical symptoms and traits and leptomorphic body build with dysthymic traits and symptoms conforms with Janet's dichotomy of neuroses into hysteria and psychasthenia.

The association of eurymorphs with extraverted and cyclothymic tendencies and leptomorphs with introverted or schizothymic tendencies lends support to Kretschmer's theory of an affinity between body build and personality type. The higher incidence of symptoms of autonomic dysfunction in leptomorphs corresponds to the results of a study of physique and effort syndrome by the author (Rees, 1945) in which it was found that, as a group effort, syndrome patients were more leptomorphic than normal controls, and the leptomorphic patients tended to have a life-long history of symptoms of autonomic dysfunction in contrast to the eurymorphic effort syndrome patients, in whom exogenous rather than constitutional factors were found to be important. The dichotomy in body build therefore tends to correlate with a dichotomy of temperament, neurosis and psychosis as shown in Table II.

Table II.

Body type.	Leptomorph.	Eurymorph.
Autonomic activity.	Autonomic imbalance.	Autonomic balance.
Personality.	Introverted, schizothymic.	Extroverted, cyclothymic.
Neurosis.	Dysthymia (anxiety and depression).	Hysteria.
Psychosis.	Schizophrenia.	Manic-depressive psychosis.

While the table serves to display clearly the trends of association between body build, personality and mental disorder, it must be realized that it makes absolute what are, in fact, tendencies.

In conclusion we may say that the relationship between body build, personality and neurosis in women as shown by the results of our study conforms with the results obtained in a study of body build, personality and neurosis in a group of 400 soldiers (Rees and Eysenck, 1945), and with the results obtained by Stanford (1943) at Harvard on normal children. This consistency in the trend of association between body build and psychological traits in adults of each sex and in children suggests that the relationship is fundamental.

The findings provide further evidence of complex relationships between body build and psychological attributes, but the correlations are too slight for use clinically for diagnosis, prognosis or selection, and that, while body build and other physical attributes may provide clues to mental qualities, their detection and measurement will not serve as a short cut to replace the more direct methods of elucidating personality or mental disorder.

SUMMARY.

1. The paper describes investigation into the association between body build, personality and neurosis in a group of 400 service women neurosis patients. Body build is assessed by a new index consisting of a regression equation of four measurements derived from factorial analysis. Items relating to personality, symptomatology and mental status were recorded independently.

2. The group was divided by means of the new body-build index into Leptomorphs, Mesomorphs, Eurymorphs, and the distribution of psychological traits determined for each group and the significance of differences tested statistically.

3. Eurymorphs were found to be associated with hysterical traits and symptoms, whereas leptomorphs tended to be associated with dysthymic traits and symptoms (anxiety and depressive states).

4. Eurymorphs were found to be associated with extraversion and cyclothymic tendencies and leptomorphs tended to introversion and schizothymic tendencies, thus lending some support to Kretschmer's theory of a relationship between body build and personality.

5. Leptomorphs have a higher incidence of signs and symptoms of autonomic dysfunction than eurymorphs.

6. The findings conform to the results of a similar study in adult male neurotics and with those of a study of normal children at Harvard. It is stressed that the correlation between physique and its psychological correlates is too small for clinical use in diagnosis or prognosis. The results provide further evidence of complex relationships between body build, personality and mental disorder.

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ASPECTS OF THEMATIC APPERCEPTION TESTING: DEPRESSION.*

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THE Thematic Apperception Test (*TAT*) of Murray first appeared in 1935; it consists of a series of pictures on cards, 20 of which are shown to the subject with an injunction to make up a short story based on what the people in the pictures are doing, thinking or feeling, and what he thinks the outcome will be. The theory is, of course, that the subject will "project" into his responses his own attitudes, moods, drives, desires, etc., and the *TAT* has for this reason been called a fantasy test (Masserman, 1947). Elaborate scoring methods have been developed with a high degree of inter-examiner correlation (see Murray, 1938; Rapaport, 1946; Rotter, 1940; Tomkins, 1947; Wyatt, 1947), but they are rather too complex and time-consuming for ordinary clinical purposes and all too often the examiner may fall back on a method of intuitive interpretation, evaluating responses in the light of his psychopathological knowledge and experience—that is, using experience derived from free association in a situation that is designed primarily to produce a controlled associative process. It would not, of course, be the first time that a scientific solecism had been the means of justifying a therapeutic end, but here there are two logical errors. First, the facts are being selected to fit the theory, and as Harrison (1943) says, "the analyst may project into his interpretations his private personality theories or even his own personality"; second, the experimental findings are not being evaluated against normal controls. The intuitive method is thus seen to be personal, subjective and unstandardized. The aim of psychometrics, however, is the *measurement* of personality factors, and measurement, says Carr (1925), must be "impersonal, objective and standard."

The present writers' method of approach has been to use controlled comparisons of response material, evaluated statistically. First the collected responses to each card in the control group are examined and broken down under subdivisions determined by the evocative power of the card, then the same procedure is carried out in the experimental group and the points of divergence are noted and submitted to tests of statistical significance. *It is suggested that interpretation should be based on these significant divergences.* The two groups were approximately matched for sex and intelligence, and consisted of 15 normal controls and 15 cases of depression, irrespective of whether the condition appeared to be endogenous or reactive. The degree of depression was for the most part moderate, and grossly deluded, hallucinated patients were not included in this series; the mean age of the depressed group was 47 years. The controls were members of the hospital staff—nurses, porters, social therapists, etc., and the mean age of the group was 39 years. It must be borne in mind that with a series of 30 cases (and the time-absorbing nature of the work has prevented it from being larger) absolutely representative sampling cannot be guaranteed. However, the differences which are considered significant with a group this size are large differences—as, say, the difference of 50 per cent. between 30 per cent. in one group and 80 per cent. in the other. To assess the significance of smaller differences, as between 20 per cent. and 30 per cent., larger numbers would be necessary. Further, the divergences may not necessarily be a feature of depression only—they may be present in other diagnostic groups. Different nosological groups have, in fact, been tested, but the material is not yet fully investigated. All the subjects were given the Rorschach test in addition to the *TAT*; corresponding and diverging features of the tests are noted and commented on in later paragraphs.

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* A Paper read at the Northern and Midland Division of the Royal Medico-psychological Association held at Menston Hospital, Leeds, on 21 October, 1949.

Examination of the TAT Cards.

CARD I.—*A young boy is contemplating a violin which rests on a table in front of him.**

Considering our control group responses, it was observed that they could be classified as (i) references to the boy and his drive; (ii) references to the violin; (iii) references to external forces such as "he's been told to practise" or "his mother has arranged lessons for him"; (iv) references to the boy's mood; (v) references to the outcome.

When references to the boy's drive are examined in the control and depressed groups the contrasting results may be expressed in tabular form as in Table I.

TABLE I.—P = ·10–·05.

Group.	The boy's drive.			Total.
	Ambition.	Uncertainty.	No opinion expressed.	
Control	7	4	4	15
Depressed	2	3	10	15
Total	9	7	14	30

Taking the table as a whole and subjecting it to the χ^2 test, the probability that the findings are due to chance is rather less than 1 in 20, so it is not statistically significant. However, comparing only the "ambition" responses in the two groups, there is a significant difference in so far as the "ambition" response is a common one in the control group (46·7 per cent.) and an uncommon finding in the depressed group (13·3 per cent). This is a difference of 33·4 per cent., which is 2·14 times the standard error of the difference and so may be accepted as significant, $^{\sigma}D\% = \sqrt{\frac{p_1 q_1}{n_1} + \frac{p_2 q_2}{n_2}}$. Similarly, there is a significant difference in the fact that most of the depressed patients made no reference to the existence of any drive. Doubt or uncertainty was expressed about the boy's drive almost equally in both groups.

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* The quoted descriptions of the *TAT* cards are those given by Murray (*TAT Manual*, 1943).

Going on to examine objective comments, as in class (ii) of the responses, we found that references could be subdivided as follows: (*a*) It was a "special" violin—a gift, his father's violin, a Stradivarius, etc.; (*b*) the instrument was mentioned, but no special importance was attached to it; (*c*) the violin was damaged—a string was broken, the bridge was missing, etc.; (*d*) no opinion expressed. These responses are tabulated below for the two groups of subjects. Table II).

TABLE II.—$P < \cdot 01$.

Group.	"Special" violin.	"Ordinary" violin.	"Broken" violin.	No opinion expressed.	Total.
Control	9	6	0	0	15
Depressed	0	10	4	1	15
Total	9	16	4	1	30

The χ^2 test here indicates that it is very unlikely that the findings are due to chance, and it may be taken as significant that the controls attach some importance to the violin being a "special" one, also that the depressed group not uncommonly find it to be damaged.

References under our third category, to some external force, was found in five subjects in the control group, but only in one in the depressed group (see Table III). This also is a significant finding.

TABLE III.

Group.	External force. Number of responses.	Percentage.
Control	5	33·33
Depressed	1	6·67

Difference = 26·66 per cent.

Concerning the boy's mood, it was found that this could be classed as depressed or aggressive, and Table IV shows the distribution.

TABLE IV.—$P = \cdot 20 - \cdot 10$.

Group.	The boy's mood. Depression.	Aggression.	No opinion expressed.	Total.
Control	3	2	10	15
Depressed	6	0	9	15
Total	9	2	19	30

It will be seen that the depressed group differs in showing more depression and less aggression, but not to a significant degree.

The outcome of the story, when it was mentioned at all, fell into a success-or-failure grouping. From Table V it will be seen that the depressed group scored lower in both categories, but not significantly.

TABLE V.—$P = \cdot 20 - \cdot 10$.

Group.	Success.	Failure.	No opinion expressed.	Total.
Control	4	3	8	15
Depressed	1	1	13	15
Total	5	4	21	30

This completes the analysis of Card 1 and the method has been shown in some detail as a demonstration. For the other cards examined similarly in the series, findings which may be taken as significant are indicated by italicized passages. An accompanying asterisk denotes significance at the level of twice the standard error of the difference, and two asterisks indicate significance at the level of × 3 S.E. or more. When findings are not so emphasized, they represent either tendencies which are not sufficiently prominent to achieve significance, or they may readily be due to the operation of chance. The collection of more material will be necessary in these cases before any definite opinion can be reached. The findings in the other cards examined are given below.

CARD 2.—*Country scene: In the foreground is a young woman with books in her hand; in the background a man is working in the fields and an older woman is looking on.*

A family relationship was usually found here by the controls, though *seldom** by the depressed patients. The woman's pregnant state, and also the possibility that the picture is a poster of some kind, was more often commented on by the control group. The girl's conflict between education and the farming background was well brought out by the controls, but by *few*** of the depressions.

CARD 3 GF.—*A young woman is standing with downcast head, her face covered with her right hand. Her left arm is stretched forward against a wooden door.*

In both groups the mood of the woman was uniformly interpreted as depressed. The cause of her depression was considered to be due to quarrels, family troubles, or sickness or death of a loved one in a *higher proportion** of the controls; and due to oppression (e.g. being turned out by her father) in *more** of the depressed group. The outcome of the situation, when one was given, was recovery *more often*** in the controls.

CARD 4.—*A woman is clutching the shoulders of a man whose face and body are averted as if he were trying to pull away from her.*

The man's drive tended to be too varied to give any marked differences in scoring. His attitude towards the woman showed *rejection** rather than acceptance in the depressed group. The woman's attitude was found to be persuasion, assistance or opposition, fairly evenly matched in both groups except that opposition was not found in the depressed patients. In the background a figure can be specifically interpreted as a woman or as a picture, or it may be implied that the figure is a woman, although she is not directly mentioned. This occurred more frequently among the controls in stories of an "eternal triangle" type.

CARD 5.—*A middle-aged woman is standing on the threshold of a half-opened door looking into a room.*

Comments on the woman were that she was checking the room, she was worried about something, or she was just normally and happily about her business; the depressed group had no responses in the last-mentioned category. It was a *commoner** finding in the controls that the woman was seeing other people in the room; background descriptions were mentioned almost equally in both groups.

CARD 6 GF.—*A young woman sitting on the edge of a sofa looks back over her shoulder at an older man with a pipe in his mouth, who seems to be addressing her.*

The control group commented more frequently on the woman's being startled or surprised; the man's attitude tends to be interpreted as either friendly or else intimidating. His attitude was *friendly** in the control group, and aggressive or intimidating in equal proportions in both groups. Failure to comment on his attitude was commoner in the depressed group.

CARD 7 GF.—*An older woman is sitting on a sofa close beside a girl, speaking or reading to her. The girl, who holds a doll in her lap, is looking away.*

The persons in the picture were said to be mother and daughter (or less commonly, "a woman and a girl") about equally in both groups. The doll was fairly frequently seen as a baby (and in one case as a "dead baby") in the depressed group. The little girl was said to appear sad more commonly amongst the controls.

CARD 8 GF.—*A young woman sits with her chin in her hand looking off into space.*

The girl was stated to be *thinking*** more commonly in the depressed group, and said to be "*fed up*"* more often in the controls. In a few responses she was watching, or waiting.

CARD 9 GF.—*A young woman with a magazine and a purse in her hand looks from behind a tree at another young woman in a party dress running along a beach.*

The commonest responses in order of frequency here in the two groups were (*a*) both girls are looking at something, (*b*) the upper girl is an onlooker (commoner in the depressed), (*c*) the upper girl is in some way opposed to the other (commoner in the controls), or (*d*) they are playing some game. The controls stated more commonly that they are sisters, also that the lower girl is anxious about something. One of the controls said the upper girl was seeing an image of herself.

CARD 10.—*A young woman's head against a man's shoulder.*

The two figures are usually seen as a middle-aged or elderly couple, but a minority of both groups saw them as two men. Mother-and-son and father-and-daughter responses were found occasionally among the controls. The mood is usually interpreted as peaceful, but an aggressive theme is introduced by a minority of the controls ; the depressed patients occasionally saw them as in prayer.

CARD 11.—*A road skirting a deep chasm between high cliffs. On the road in the distance are obscure figures. Protruding from the rocky wall on one side is the long head and neck of a dragon.*

The card was rejected by 26 per cent. of both groups ; the serpent-like creature was not mentioned, or was called something innocuous like " a goose," in a minority of both groups. The figures on the bridge are seen as " little men " more often in the controls ; a majority of the depressed group interpret the figure as some kind of peaceable animals running away.

CARD 12 GF.—*The portrait of a young woman. A weird old woman with a shawl over her head is grimacing in the background.*

The old woman is seen as unpleasant or menacing in about half of each group ; anxiety in the young woman was mentioned more by the controls, also the possibility that they are both looking at someone else. Equal minorities of both groups saw the old woman as a nun or a witch ; the depressed patients had uncommon responses of seeing her as a man, or fancying that the young woman was seeing an imaginary future picture of herself.

CARD 13 MF.—*A young man is standing with downcast head buried in his arm. Behind him is the figure of a woman lying in bed.*

This card rarely failed to evoke a thematic response, the commonest (control) explanations being murder and/or rape, seduction and illness or death. Among the depressed patients illness or death was the commonest theme, seduction was almost equally common and sexual crime only half as common. The production of alternative themes is *much higher*** in the controls.

CARD 14.—*The silhouette of a man (or woman) against a bright window. The rest of the picture is totally black.*

The depressed group usually see the figure as looking out into the light (commonly moonlight); the controls *more often** picture the room as light inside and the figure looking out. In the control responses with the figure looking towards the light, it was usually daylight or dawn. Alternative explanations were again *more frequent*** in the control group.

CARD 15.—*A gaunt man with clenched hands is standing among gravestones.*

About two-thirds of each group interpreted the card as depicting an actual situation (a man praying for a dead relative, a body-snatcher, a criminal repenting, a madman, a dying man) and one-third saw it as a symbolic figure of death or a ghost. Responses could be classed as criminal themes (*commoner** in the controls) or moral themes (equal in both groups).

CARD 16.—*Blank card.*

A wide variety of responses is of course met with here, but the controls showed the following order of frequency: (i) landscapes; (ii) responses with some personal interest; (iii) responses concerning other people; (iv) responses concerning the family. The depressed group's responses fell into quite a different order of frequency, family responses predominating by a *large majority** and the other responses being *much more scattered.** Separation from the family throughout hospitalization may, of course, play a large part here.

CARD 17 GF.—*A bridge over water. A female figure leans over the railing. In the background are tall buildings and small figures of men.*

The controls *more often** saw this as a girl waiting for her husband or lover; the second commonest theme was that the card depicted smugglers, this, too, being *more frequent** among the controls. Themes in which the girl is merely looking at the water were *commoner** in the depressed group. Two depressed patients saw it as a peaceful scene, and only one made any reference to suicidal possibilities.

CARD 18 GF.—*A woman has her hands squeezed around the throat of another woman whom she appears to be pushing backwards across the bannister of a stairway.*

On this card the controls more often saw the woman as throttling the girl (aggressive theme) and the depressed group more frequently saw the woman acting in a punitive capacity; about half of each group interpreted the woman as comforting or assisting the girl following illness or accident. There were no great differences in the relationship of the two figures, but the smaller figure was seen as *masculine instead of feminine** in a number of the depressed responses.

CARD 19.—*A weird picture of cloud formations overhanging a snow-covered cabin in the country.*

Many of the controls called this a futuristic picture (or something similar) though *few of the depressed did so,** and references to storm or snow were *more* *frequent** in the controls. Some of both groups thought the house looked snug, although the storm was raging outside.

CARD 20.—*The dimly illustrated figure of a man (or woman) in the dead of night leaning against a lamp post.*

The figure is usually taken to be a man, though some of each group said it was a woman ; vague descriptions like "someone" were *commoner*** in the depressed group. References to the person's mood being depressed were *more often found** in the controls.

TAT—Mean Score Values and Correlations.

Categories scored in the *TAT* were (i) Themes, classed as Popular Themes, Superior Themes and Alternative Themes ; for scoring purposes these were given arbitrary marks of 1, 2 and 3 respectively ; (ii) Identification, scored when the subject made a *definite* identification of himself in the story ; (iii) Faulty Percepts, as when the subject described a female figure where a male is depicted, or otherwise produced a distorted mental image of the picture ; (iv) unusual or abnormal thematic material ; (v) Delayed responses ; (vi) failed or rejected cards. Reasons of space preclude giving a full table of scoring values, but the following differences between the control and depressed groups may be mentioned.

The depressed group scored lower values for Total Time, Mean Response Time, Range of Response Times and Alternative Themes. Popular themes were scored about equally in both groups, Superior Themes were scored significantly** less frequently among the depressed patients ; elicited thematic material, also unusual or abnormal material, was higher in the depressed group. Identification with the figures in the pictures was slightly commoner in the depressed patients, and faulty percepts were significantly* commoner (this may be a function of the slightly higher mean age of the group) ; failed or rejected cards were significantly** commoner in the depressed.

Examination of the coefficients of variation indicated that the depressed group tended to show less variability in *all* except the following scoring categories—Popular Themes, Identification and Ratio of longest : shortest Response Time ; these were more variable than the controls.

The Mean Response time to each *TAT* card was also calculated for the two groups. Fig. 1, a histogram demonstrating the findings, indicates the longer response time of the controls and also their greater variability of response times. It will be seen that Card 9 GF, the two abstract cards (11 and 19) and the blank card (16) produced most hesitation among the controls ; Cards 11, 16 and 9 GF also possessed the longest response times in the depressed group, though the hesitation is less pronounced than in the controls. The mean response times of two groups are most similar on Cards 4, 7 GF, 8 GF and 20, and the discrepancies in mean response time are most marked on Cards 19, 9, 5, 11, 12 and 16 respectively.

Significant positive correlations within the *TAT* were (*a*) number and quality of Themes & Intelligence, $r = +0{\cdot}66$, (*b*) number and quality of Themes &

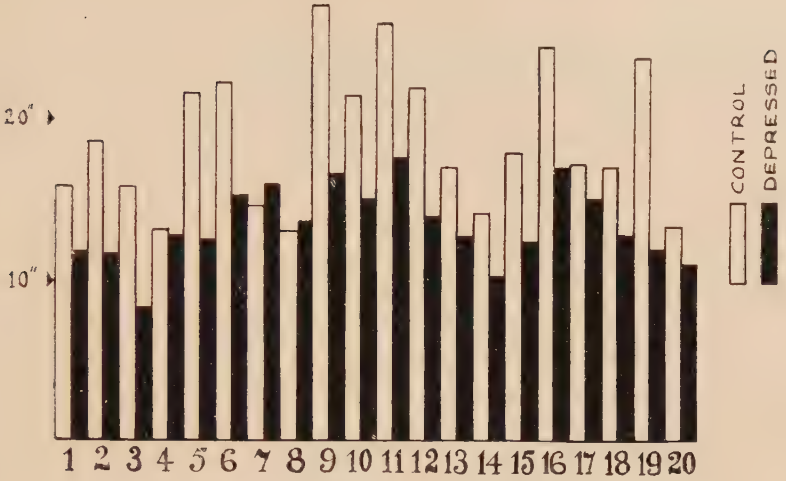

FIG. 1.—*TAT*: Mean response-times (seconds) of the control and dependent groups to each card.

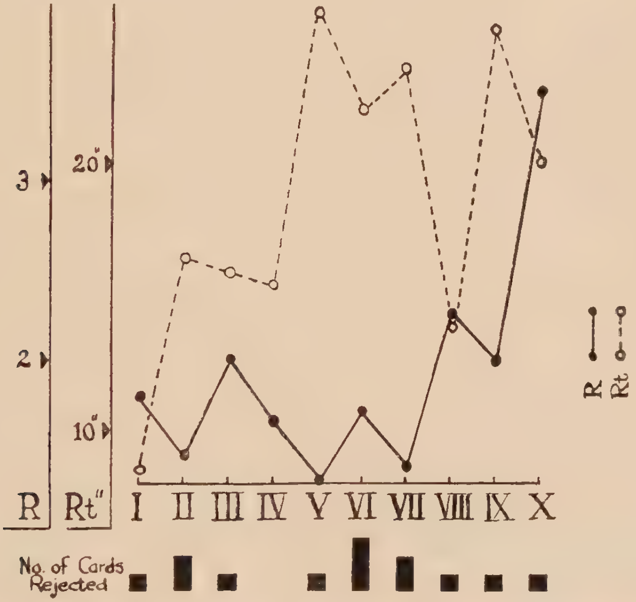

FIG. 2.—Rorschach Test: Mean number of responses (R) and mean response-time (Rt) of the depressed group to each plate.

Total time, $r = +0{\cdot}64$. There was no correlation between Themes and Mean Response Time.

Comparison of the TAT and Rorschach Test Scores.

With regard to the Rorschach test, it is not proposed to give the findings in any detail, and it is sufficient to mention that the results are in accordance with studies published for series very much larger than this (see Beck, 1944; Johnson and Sherman, 1948; Rapaport, 1946). However, certain findings with regard to R (number of responses) and Rt (initial response time) may be of interest. The longest response times in the depressed group were on Rorschach Cards V, IX and VII, and the shortest was on Card I; Card X was most productive of responses, and Card V least productive. Card VI was most often rejected and Card IV was the only one not to be rejected at all. The relationship of these scores is shown graphically in Fig. 2; there is no correlation between R and Rt ($r = -0{\cdot}09$).

It was noticeable that for scores common to both tests, such as Mean Response Time, Total Time and Number of Responses (or Themes), the coefficient of variation was considerably lower in the *TAT*. To some extent this might be anticipated, as the *TAT* presents the subject with a more formal situation than the rather amorphous blots of the Rorschach. Regarding correlations between the Rorschach and *TAT* tests, the only significant ones were (*a*) F + & Themes, $r = +0{\cdot}56$; (*b*) number of cards failed or rejected in each test, $r = +0{\cdot}56$. Non-significant positive correlations included the following:

R & Themes.
R & Alternative Themes.
dd & Themes.
Rorschach Response Time & *TAT* Response Time.
Rorschach O-Scores & Abnormal Themes.

and non-significant negative correlations were:

A & Themes.
W & Themes.
F + & Faulty Percepts.
H & Identification.
Sum C & Identification.
Rorschach Total Time & *TAT* Total Time.

There was no correlation between Rorschach O + & *TAT* Alternative Themes, nor between Rorschach O − and *TAT* Faulty Percepts.

One of the correlations between the two tests is perhaps worthy of special mention. An abnormal type of Rorschach response, not uncommon among depressed patients, is what one might call a "disrupted anatomical" response. A few examples from different cards in several patients may make the meaning clearer than description.

Card I: That could be part of the skin of a frog.
,, II: Looks like somebody's intestines or something, shot open, burst open. Blown to bits.
,, II: Flesh and blood.
,, IV: I should think something split open, spread out, dissected. Could be a human being . . . backbone, buttocks, legs and arms, head squashed.
,, X: It's a fish, but it's been separated—it's in parts but it's fish. Head here—the rest is pieces of the body.

It was noted that the same patients tended to give the "broken violin" response on *TAT* Card 1, also "broken doll" responses on Card 7 GF. The number of disruptive-anatomical Rorschach responses was correlated with the number of broken-violin plus broken-doll responses over the series, and a significant positive correlation was found, $r = +0{\cdot}79^{**}$.

Discussion.

One important secondary difference between the control and depressed groups was, of course, that the latter was hospitalized; this appears most clearly in Card 16, but it may possibly be a factor behind other differences.

Summing up the significant differences between the two groups, first, the depressed are less versatile. The stories of the controls are imaginative, whereas among the depressed one finds static description and at the best a single suggested action and outcome. It seems to be this failure of imaginative thinking which causes rejection of more cards by depressed patients rather than specific, complex-determined emotional precipitants. This is what Beck calls the lethal effect of depression upon the imagination.

There is also a levelling effect upon performance. That is, when presented with a standard test the depressed patients perform much more to a pattern than do the normals, and show less variability or individual difference. This holds good not only for imaginative content but also for a number of the quantitative scoring categories.

The depressed patients lacked drive and had no desire to come to grips with the world; in Card 1 the boy lacks ambition, the external reality (the violin) is undistinguished or broken. They avoid human relationships (there are no other people imagined in Card 5; the boy is not considered in relation to his family in Card 1; the characters in Card 10 are praying, not embracing). When other people are depicted they may be rejected as in Card 4, and in Card 9 GF the second figure is not actively involved with nor related to the other. The controls suggest emotional relationships with other people, and if the figure is solitary, he or she may be unhappy although the ability to recover is allowed. To a depressed subject loneliness is an ordinary situation—the person is just thinking. In Card 14 the depressed patient tends to look into a moonlit world, whereas the controls either see a new dawn and the hope it brings or else they themselves are sitting in the light. The future is not visualized and few outcomes to the stories are given by depressed patients. The unreality of Card 19 is passed over, whereas the controls seldom fail to comment on it. Aggressive responses directed externally are not, as might be thought, fewer in depressed patients nor (as has been suggested) are they infrequent in controls.

The outstanding features are the partially withdrawn state of the depressed patient and the alteration of the reality he sees around him. There is an emotional and apperceptional change of state to a dim, inert Nirvana from which he surveys the decay of the universe.

It is difficult to draw firm conclusions about the relationship of the two tests in so far as they may be coincident or complementary. However, there does seem to be a definite relationship between good form responses in the Rorschach and the productivity of *TAT* themes ; also, the person who fails cards in one test is likely to fail cards to a similar extent in the other. Both of these correlations may well be a function of the intelligence of the subject. They were the only significant correlations obtained, but some interest also attaches to absence of correlation. For example, there is no indication that the subject who produces good original Rorschach responses will also produce a multiplicity of themes on the *TAT* ; nor does the subject who produces the autistic type of Rorschach O – (poor original) response necessarily tend to produce apperceptional distortions on the *TAT*. Further, when human forms are seen on the Rorschach it does not follow that the subject will tend to identify himself on the *TAT* pictures ; and in so far as the amount of time spent on the tests is a measure of ability or interest in them, there is no indication that subjects tend to behave similarly on both.

There is a suggestion that the depressive syndrome is recognizable in certain aspects of both tests—as in the fixed type of approach and the very low productivity in creative imagination ; but it also seems possible that the level of organization affected by the illness may be detected by the differential ability shown in the two tests. Our work with them in other diagnostic groups suggests that the Rorschach is an indicator of the personality's imbalance within itself, whereas the *TAT* may indicate the degree of adjustment preserved towards outer reality. An example may clarify this statement—in acute psychotic states of good prognosis, such as brief catatonic reactions or "bromide schizophrenia" the Rorschach is noticed to show a typically schizophrenic and autistic configuration, whereas the *TAT* is much more satisfactorily performed. A contrasting picture may be demonstrated in schizophrenia, catatonic type, where high imaginative productivity may be shown to be retained on the Rorschach, though the *TAT* thematic material is of poor quality and of a bizarre nature. In a process schizophrenia of hebephrenic type both records will be poor in quality and showing autistic variations.

A final investigation was to score the depressed patients according to whether their Rorschach or *TAT* records more nearly approached normality. When this was done it was noted that there was a tendency for cases of good prognosis to show a better performance on the *TAT* ; this may imply a better grasp on reality which would be prognostically favourable.

SUMMARY.

The Thematic Apperception Test and the Rorschach Test were given to two matched groups, one consisting of moderately depressed patients and the other a series of normal controls. The objectively evaluated material of the control group was used as a norm, and responses of the experimental group which diverged from this to a statistically significant degree were taken to be associated with the depressive syndrome ; these are noted and discussed, and it is suggested that divergences of this nature should form the basis of *TAT* interpretation. Correlations between Rorschach and *TAT* scores are discussed ; from the findings it seems likely that the two tests plumb different levels of

personality integration, and differential performances on the tests may be of assistance in diagnosis and prognosis.

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REACTIVE PSYCHOSIS IN ADOLESCENCE.

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THE period of adolescence includes within its span the shorter phase of puberty, and may extend from prepuberty as early as ten years (1) to adult maturity attained perhaps in the early twenties. A study of psychosis in adolescence must therefore take cognizance both of the psychoses of later childhood and of early adult life.

PSYCHOSES IN CHILDHOOD AND ADOLESCENCE.

The earlier accounts of the psychoses in childhood are confused by the fact that children from infancy to sixteen or more have sometimes been included in the same series. Prior to puberty psychoses are rare, though more frequent than has sometimes been claimed (2). Nomenclature has also been, and remains, confused by uncertainty as to those entities in which primary organic degeneration is present (3). Lay's (4) review of the earlier writings gives a comprehensive *résumé* of these problems.

The modern concept of schizophrenia in childhood was first formulated by Potter (5) and he established definite criteria for its diagnosis. Bradley (6) later reviewed the subject fully. Bender (7), using strict and careful criteria, further defined and clarified the clinical picture and Kanner (8), (9), later differentiated the condition of "early infantile autism."

The earliest onset of schizophrenia is uncertain, but it may appear in very early childhood. Lutz (10), reviewing the literature up to 1937, could find only ten children in whom the diagnosis of undoubted schizophrenia was made before the age of six, and ten more in whom it had appeared by the tenth year. Kanner (11), however, states that it can occur in the first six months of life. Its course is, on the whole, insidious and prolonged, carrying an ominous prognosis, particularly in younger children.

Little is known of the incidence and course of manic-depressive psychosis prior to puberty, apart from its extreme rarity: cases suggesting this condition have all been over ten years old. Diagnosis is fraught with difficulty, and again, organic conditions, including encephalitis, have to be excluded. Most instances described have been in adolescent children over thirteen, but Kasanin (12) stated that they carried an ominous prognosis.

With puberty there is an immediate rise in frequency of cases of schizophrenia, and this rise steepens in the next decade (13). Manic-depressive psychosis also becomes more common and schizo-affective states are not infrequent. Subsequent to puberty, psychoses usually approach an adult form and can more easily be perceived and diagnosed in adult terms. Therefore, although no artificial separation can be made at puberty between those psychoses that occur in earlier childhood and those that occur in adolescence, there is, in general, this qualitative change in their symptomatology. The physiological and psychological changes of puberty also constitute intrinsic and extrinsic etiological factors of importance in the subsequent development of a psychosis, although difficult to estimate in the quantitative sense (14).

Episodic Psychoses in Childhood and Adolescence.

In contrast to the general view, that psychoses in children have a prolonged course, some later authors have pointed out that there may be an acute onset and a short stormy course, abating in a few weeks without usually complete recovery and with varying degrees of impairment. The acute phase may be repeated with further deterioration. Despert (15) described twenty-nine such children, of whom nine were below the age of seven, and twenty between the ages of seven and thirteen. Kanner (2) also distinguished between cases of insidious and acute onset, and stressed that the latter usually occurred in older children. Although schizoid features may have previously been present, many such children appeared normal to relations, who often described them as model children owing to their studiousness, submissiveness and obsessive drive for perfection.

He stated that in such cases there was frequently a relatively sudden drop in scholastic efficiency with diminished powers of concentration, and complaints of headache or other physical discomforts. This prodromal stage was followed by a turbulent psychotic condition with acute anxiety, sleep disorder, motor restlessness, disturbance of speech, occasional hallucinations, general perplexity, bizarre bodily sensations, and loss of contact with people in the environment. Such an episode, often precipitated by physical illness, operation or a major emotional upset, lasted a few days or less and gradually tapered off, though occasionally it acted as a " catastrophic reaction " from which the patient never recovered. Sometimes there was a return to the prepsychotic mode of living, but very often the remission represented merely a " recovery with defect," and was followed by other acute episodes, each of which left the patient with a further reduction of his ideo-affective activities.

While some episodic psychotic states in adolescence can readily be diagnosed in the terms described above, not infrequently cases are difficult to classify, and this indeterminate quality has recently been emphasized by Edelston (22). Childers (16) described episodic states in children between the ages of ten and sixteen, precipitated apparently by physical or emotional trauma in children of the " schizoid reaction type." These children often showed an unusually strong attachment for the mother, perhaps over-compensatory ; they had often been much away from other children and given to excessive phantasy. They might show an unusual position in the family and their circumstances were always unsatisfactory.

Other authors have briefly mentioned similar indeterminate episodes, including Vogt (17), Cottington (18) and Creak (19). The last described three children aged between eleven and twelve, whose condition seemed to have a strongly reactive element to events of emotional significance in the environment. Lutz (10) called such cases pseudo-schizophrenia, in that they were not progressive and appeared to have the prognosis of the provoking factor. Some authors including Van der Horst (20) stressed that these episodes occur about puberty or in adolescence, and has suggested that they are peculiar to this time of life.

Kasanin and Kaufman (21) analysed twenty-one patients previously diagnosed as schizophrenia, all between the ages of thirteen and fifteen, admitted to the Boston Psychopathic Hospital. This analysis revealed that only six of them could be definitely confirmed as schizophrenia, and two more as schizophrenia engrafted on mental deficiency ; the others they considered included two cases of psychosis grafted on psychopathic personality, one case of traumatic psychosis, two of toxic psychosis and two of "psychosis with hysterical manifestations." In addition they distinguished five cases, four girls and one boy between the ages of fourteen and fifteen, to whom they gave a diagnosis of "reactive psychosis." These patients showed a peculiar but definite emotional response to a particular situation, and such an atypical response had led to the previous diagnosis of schizophrenia. They had, however, all had obvious precipitating emotional traumata, and the illness did not appear to be malignant, in that a perfect recovery ensued and they remained stable afterwards over a prolonged period. They added, however, that in two of the patients there was an affective colouring to the illness, which may have been partially responsible for an apparently benign course.

The authors suggested that such reactions in children were quite different from the responses in adults, and what would seem an extremely serious and malignant reaction in an adult might be fairly intelligible and matter of fact in a child. It was perhaps a building up of phantasy life with expression in symbolic, and sometimes queer, behaviour. With such small numbers it was difficult to distinguish any special etiological factors, but it seemed definite that their heredity was less serious than in those patients with a definite schizophrenia or manic-depressive psychosis. The home situtation was very poor, in the emotional sense, in all five cases, but the effect of this was not clear. Sexual preoccupations and difficulties were also prominent in them. The authors stated that previously these patients had only been seen in cross-section, and there had been no earlier opportunity for a full evaluation of the data. They stressed broad similarities in many cases and that there was fading of one case into another.

Detailed study, and particularly of the facts elicited during psychotherapy, is important for the further understanding of such patients.

Present Investigation.

The authors have selected six cases between the ages of eleven and sixteen who showed brief psychotic episodes. These appear to be similar to the groups described by Childers (16), and named by Kasanin and Kaufman (21)—"Reactive Psychosis of Adolescence." In addition, our findings in these patients are in some ways akin to the older children described by Kanner (2) and regarded by him as having an episodic form of schizophrenia. Thus a "model child" background—more clearly seen in the boys— and the evidence of a prodromal phase followed by an acute onset were all described by Kanner. Our cases did not, however, end in impairment or schizophrenic defect, as described by him, but recovered or adapted at a better level than before the illness, as Kasanin and Kaufman (21) noted. Prolonged follow-up will be needed to determine their ultimate prognosis.

CASE RECORDS.

CASE I.—K. V—, a boy of eleven, prepubescent, of a chubby build, was admitted in an acute state of panic. The illness had started six weeks earlier with sleeplessness, fears of burglars at night, and generalized apprehensiveness by day; with fears of his father's unemployment, of blackmail by a maternal uncle, that his mother and elder sisters were debauched, and that neighbours and children outside were trying to keep him awake. The initial acute phase had subsided in three days, but mild irritability and anxiety had persisted. A second acute phase then supervened, in which he was admitted. He was restless, overactive, importunate for reassurance but unable to trust anyone, repeatedly bursting into tears. He complained of dirty thoughts, feared his penis was to be operated on, that the nurses would poison him, and believed that hospitalization was a plot of his uncle's. His thoughts were so vivid that they "talked to him," saying, "You'd better get out of this. It is an asylum, Keith." With rest, sedation, free fluids and reassurance, the acute phase cleared up in a week; residual anxiety was relieved by discussion of sexual difficulties. Later, as an out-patient, he showed recurrent phases of mild depression and anxiety with the gradual emergence of psychosexual preoccupations over a long period, yielding to cautious interpretation. Considerable adjustments to his home and education and work with his parents were also required.

Three years later he had grown into a well-built youth, happily involved in a family unit of manly interests, his growing masculine confidence betraying itself in a mild attack of calf love.

The more intimate study of the case revealed a psychosexual pattern of response to maternal overstimulation, an ambivalent attitude to a mild father and an aggressive uncle whom he admired and dreaded. There was also evidence of masturbation fears, incestuous impulses towards his sisters, and castration fears,

The family history was not good. The mother, aged thirty-nine, was occasionally depressed. A maternal uncle was moody and aggressive, with periods of anxiety and depression. Another maternal uncle had been, since adolescence, in a mental hospital. The father, aged forty-five, was a mild, rather inadequate personality. The parents were attached to each other, but there were many stresses in the relationship. The mother, intelligent, ambitious and forceful, regarded the father with affectionate contempt, barely concealing a greater respect for her aggressive, prosperous and somewhat dubious brother—the villain of the patient's phantasies. The patient, an only boy, was younger by six years than his two sisters. The mother, lavishing her warmth and ambition on her family, had initially not wanted the third child, but from his birth had made him her favourite. As a child he had been docile and contented; passed the milestones normally; he was evacuated at four with his sisters for eighteen months, and again towards the end of the war for six months. He was of high average intelligence (Stanford Binet I.Q. 125 approx.). His school career had been good; he was near the top of his class, valuing success and the approval of the teachers, but rather timid and solitary with contemporaries. Up to the onset of his illness he had slept in a bed in his parent's room, getting in with his mother in the mornings. About six months prior to his illness he had begun to worry about erections and genital play, stimulated by the talk of fellows at school. He had been rather crudely enlightened by his father with analogies from domestic animals. At the same time he learned, through an aunt, of his mother's recent miscarriage. There had been some quarrelling with the aggressive uncle, who had made threats against the father. At school he was trying to stand up to some bullying. The acute illness was precipitated by his mother's entry into hospital for a gynaecological operation. During this time he had slept with his father but was very disturbed, and the acute phase leading to admission followed.

CASE 2.—J. K—, a boy of 13½, still prepubescent, was admitted some months after an acute psychotic episode. Emotional disturbance had followed a circumcision seven years earlier, since when he had been afraid of hospitals and of strangers, and had been nervous and fidgety. The acute psychotic episode had supervened at a schoolboy camp, where he was reported on as having become excited, wandering about " in a dream," and answering irrelevantly; he expressed dread of dying, showed great fear, covered his eyes and shuddered, walked with a rigid jerky gait, giggled excitedly and frowned. These had subsided in a week, but he had remained clumsy and inco-ordinated, garrulous and almost incoherent, and his school work had deteriorated. He was irritable at home, aggressive towards a young sister and had periods of " absence."

Admitted some months after the acute episode, he was restless and inco-ordinated in his movements and extremely self-conscious. Speech was almost inarticulate with garrulous rushes of talk and incoherent attempts to explain his feelings. Orientation was correct and there was no clouding of consciousness. He complained of unreality, odd feelings in his head, was hypochondriacal about his physical health, deplored his small genitals and feared they might disappear. Further interviews revealed intense castration fears almost directly expressed, or emerging in somatic or psychic phantasies of loss of arm and leg, preoccupation with excision or cuts, dreams of a man having his head crushed or injured, a sense of his body being small and weak, and a feeling of worthlessness and ineffectiveness. Imagined threats from his father, policemen or other boys were interwoven with this theme. He formed a good relationship with a woman psychiatrist, and therapy was of an analytical character. At first a generally passive attitude towards men was prominent, and with exacerbations of anxiety there emerged a disintegrated preoccupation with the female body; but after six months there was an increase of self-assertion and security.

The mother, aged thirty-seven, was detached, unemotional and unapproachable. There was some evidence of marital disappointment and overprotectiveness of the patient. The father, aged forty-eight, was tense, irritable, well-meaning but unsympathetic and dominating. A young sister had been born when the patient was ten. The patient was full-term, placid and easy to bring up. Habit training was firm. Thumb-sucking occurred in the earlier years, and he was demonstratively overaffectionate. A series of childish illnesses had involved hospitalization twice before six. Masturbation was reported about this time. Following circumcision at six, he was in terror at finding his genital bleeding, and this fear persisted. During air raids he had developed functional abdominal pain and vomiting. He had a good scholastic career (Stanford Binet I.Q. 111). His only friend, however, was a girl cousin, and his mother kept him from the roughness of boy scouts. The birth of his sister caused no apparent disturbance, but subsequent to his acute phase he showed jealousy of her. Prior to going to camp he had joined an ambulance class and asked for sexual enlightenment. At camp he reported sexual talk and genital play, and alleged he had overheard a plan to put bootblacking on his genitals.

This youth was constitutionally timid and immature, and the mother had not created a secure relationship. The effects of several periods of hospitalization, the gross trauma of circumcision, and the failure of the father to play a normal role had resulted in an only partially successful childhood. This adaptation had broken down under incipient puberty and sexual enlightenment. The separation from home and the close association with boys who made further threats had precipitated the acute episode. The final outcome is not yet established.

CASE 3.—T. G—, a girl of 15½, normally developed, one year past menarche, was admitted after an acute psychotic episode following appendicectomy. The appendix had been gangrenous and she was treated with drainage and penicillin, but physically her post-operative state had been good. There was the usual slight pyrexia in the first forty-eight hours. For a month or two previous to the operation she had had depressed moods when she would sit and weep. The operation had been precipitated by an attack of abdominal pain, and when removed to hospital she had been tearful and distressed, calling out for her mother. Twenty-four hours after the operation she seemed weak and distressed, but that evening was well, recognized her family and talked to them. She called her father back and told him there was something she should tell him, but he " would not like her if he knew." She was coherent and orientated. The following day she " seemed to have lost her memory," failed to recognize her parents, refused food and wandered round touching things, occasionally tearful or humming " Nuts in May." For some days she alternated between restless excitement and apathy, settling into a childish, facile state. After transfer to the Maudsley Hospital some six weeks later, she became settled and peaceful, but retained a childish, labile mood recognized by her parents as not normal. The scar was healthy and blood examination, etc., showed no evidence of sepsis. She remembered the post-operative period but denied refusing food, etc. She had several attacks of breathlessness. Eventually she established confidence in her psychiatrist and described her illness as starting three years earlier, when she had returned from evacuation during the war years with her mother and sister. She disliked the house and neighbourhood, felt cramped, hated school (I.Q., Wechsler 85—not reliable), was depressed and hopeless, afraid of the dark and particularly of a dark cupboard in the house. Further back, from the age of seven, she had had attacks of " asthma " when she and her mother had visited her father in London. There was now general improvement, and she next described how sexual problems had worried her since she was ten. Subsequently she reverted to normality, and remained well and cheerful and was at work six months later.

Her family history showed no psychopathy. The mother, aged forty-four, was garrulous and excitable ; the father, aged forty-two, mildly domineering. The patient, eldest of three, was notably the father's favourite. Her birth was normal full-term, and she was breast fed. As a child she was a nailbiter and afraid of boys. Information about menstruation, which first occured at 14½, was picked up crudely at school ; she worried about its delay in onset as compared with other girls. In the year prior to operation she had once been followed by a tramp, and on another occasion she and her sister were pursued by youths who had caught up with her sister, when the father, summoned by the fleeter patient, drove them off.

The illness was summed up by the patient—" I think it was all growing-up and having those worries." Her attachment to the father was significant. In addition, her slight intellectual handicap made educational progress difficult ; return to an uncongenial town life, and the tensions of puberty so heightened a disturbance of years that her acute phase supervened with appendicectomy.

Case 4.—I. V—, a girl of thirteen, was seen as an out-patient after an acute psychotic episode at a girls' camp. She had behaved strangely and irresponsibly, with alternating moods of depression and excitability. She accused her friends of talking about her, walked in her sleep, and after a horrific film made several attempts to run away. Having been sent home she was admitted to an observation ward where she was said to hallucinate " whispering voices." Transferred to a mental hospital she was promptly discharged as an " unhappy child." When seen at the Maudsley Hospital, some weeks later, she was found to be a slight, pale child, timid and depressed, responsive to encouragement but uncommunicative. Work was mainly with the stepmother, but impaired by the distance travelled. After some months the child was brighter, more communicative and now showed pubertal development. She returned to school, where she was reported bright and spontaneous. A year later she was working in a factory. An I.Q. of 65 (Stanford Binet), as an out-patient, was regarded as unreliable owing to the patient's disturbance.

Her history showed a normal birth, but when the patient was four the mother was admitted to a mental hospital with paranoid schizophrenia. In the absence of the father on war service, the patient was brought up in the casual rough-and-ready household of an uncle. She showed much attachment to her father on his leaves, and knew of her mother's hospitalization. A year before the patient's illness the father contemplated remarriage and the child then stayed with her new stepmother, a widow with one child. Subsequently, four months before her illness, severe domestic difficulties developed. The stepmother did her best, but was tense, over-anxious, rigid and old-fashioned in her ideas. They lived above the late foster-parents, with friction and divided loyalties for the patient. The latter was jealous and possessive of her father, " pushed " between him and her stepmother, and scandalized the latter by her blatant affection. Finally, the patient maintained that her own mother was being shut up and might have returned to them. A school camp was welcomed by the stepmother and interpreted by the child, with some correctness, as an effort to get rid of her. There was no information of any trauma at camp.

Knowledge of this case is incomplete, but it illustrates an acute psychotic episode in a maturing girl related to severe interfamilial stress and precipitated by a school camp. Full recovery took place.

CASE 5.—B. T—, an adolescent girl of 15½, normally developed, the only child of elderly parents, was seen as an out-patient following a holiday during which she had had an acute psychotic episode. She was later admitted for closer observation.

Menarche had occurred two months before the illness ; she was at the time studying hard. She had since thought children were looking and shouting at her because she had continued at school. On holiday in Ireland with her parents she felt depressed and tired, and was reported as excited, restless and sleepless. She then went by herself to stay with the aunt in Ireland with whom she had been evacuated. She felt she had done wrong to leave her parents, and set out to walk back. On the way she saw men near a church and decided they were watching her. She became distressed, wondered if the church had been built for her, but felt she had lost her religion, though later she thought that she was to be martyred—cut up and put on a fire—and would return as a ghost and save the people. She then saw ghosts in the church who said, " You will soon be with us." Finally, she considered that she was stupid and then losing touch " felt confused." Returning to her parents she thought her mother had " jealous eyes." On the way back to England she felt like jumping overboard, but thought she would be rescued. In her home she remained vague, puzzled and detached. Seen at the Maudsley Hospital three weeks later, she complained at first only of backache, but was able to describe the above experiences with hesitating insight. She believed she had had an illness that had left her rather weak and made concentration difficult. In the subsequent months she remained passive and detached, and said that at her period she had had a recurrence of the feeling she was in purgatory. Finally admitted to the hospital three months after the holiday, she appeared happy in the ward, and no abnormality was found in her behaviour or mental content. She returned home and to school. Further contact was difficult as her parents were defensive and resented the association with hospital, but her mother reported her as idle and withdrawn. A home visit revealed a tense situation, in that mother and daughter appeared to be covertly jealous of the other in relation to the father, a suspicious overbearing man.

The family history was relatively stable. The father, aged sixty-one, had developed neurasthenia after the first world war. The mother, aged fifty-four, was somewhat nervous and anxious. The family interrelationships were difficult to assess. Both Irish and Roman Catholic, the parents led a life isolated from their neighbours ; the father apparently dominated the situation, the mother's attitude suggested hostility to the daughter under a cloak of amity.

The patient had a normal full-term birth and was breast fed. She was described as a restless, active child, but shy, making only one close friendship. Sleepwalking had occurred. School had been relatively successful till fifteen, but this had involved very hard work (I.Q. 76, Wechsler full scale). The family ambition was that she be a teacher.

As far as can be judged stresses lay in the family situation to which she returned after years in Ireland, in educational pressure and the developmental stresses of puberty. The immediate recovery from her psychosis was good, but the emotional situation was little affected by psychotherapy.

CASE 6.—I. N—, a girl of thirteen, fully developed, was admitted to hospital with the history of an acute illness which had lasted three weeks, and had been precipitated by the departure of her mother on holiday, leaving the patient at home with the father and grandfather. She had awakened with the smell of " gas," said someone was breaking in, and wandered round the house. Fear at night persisted after her mother's return and she disturbed the household. The smell she associated with dental gas during an extraction a few months before. On admission she was depressed, tearful, but quickly became settled in hospital though she long remained anxious, unwilling to meet the outside world, and occasionally depressed. With psychotherapy she gradually revealed an interest in and fear of men, particularly her father. She described choking feelings when left alone with him, and dreaded that he might hit her. Eventually she produced phantasies of intercourse with him.

At first dependent on her mother, she expressed great distress at the worry she caused her, but her actions might easily have been regarded as designed to augment that worry. She finally realized this hostility to her mother and jealousy of her next sister. She eventually emerged with psychotherapy as cheerful, a good mixer, rather the dominating spirit in the ward, and was able to return home with success.

Her father, aged thirty-five, was stable, while her mother, aged thirty-six, was nervous but warm-hearted. Marital relations were good, with occasional mild rows. The patient was the eldest of three daughters. She was full-time normal birth, breast fed. She was always nervous and afraid of the dark. Tonsillectomy in hospital at three caused no great upset. She was always slightly jealous of her next sister, born just at this time. During the war she was evacuated to the country with her mother—at that time she used to run away to find an uncle who lived near. At school she made only transient friendships with other girls, but liked teachers and got on well (Wechsler Bellevue, I.Q. 100). She had been afraid at the birth of the third and post-war sister, fourteen months before her illness, but was delighted with the baby. Menarche at twelve caused some worry. The dentist who had extracted her teeth with gas had been "a nice man," but the smell was also associated with a man who she thought had looked at her at a cinema. She was afraid of men.

This girl showed emotional disturbances dating back to the birth of a younger sister when she was aged three. Puberty had coincided with the reintegration of the family and the birth of the third sibling, and the illness had been precipitated when the mother had left her in the house alone with the father.

DISCUSSION.

Several observations of interest emerge from these case records.

The family histories were not uniformly bad; two, it is true, showed psychosis in the immediate background, but in the other four nothing more than moderate anxiety showed in the two previous generations. The marital relations of the parents were significant—in all they were formally stable, but in the case of both boys the mothers were not emotionally satisfied in their marriage, and the boys appeared to be unduly involved in the maternal pattern of life. In the case of each of the girls the parental relationship appeared more complete, but three of the girls were spontaneously described as being particularly attached to the father: the fourth (Case 6) showed in her content the attachment to the father more manifest in the other three. The significance of this triangle was enhanced by the rather specific position held by the patients in the family pattern. The two boys were respectively the youngest and eldest of a family, of whom the other members were girls. Two of the girls were first-born and the other two only children. In every case developmental stresses were enhanced by an undue attachment to the heterosexual parent.

Differences which may be fortuitous appeared between the sexes in intelligence level. Both boys were above average intelligence, while the girls were rather below. All six, however, were more deeply involved in the educational process than the majority of children. The boys tended to excel in the scholastic sphere, and the girls consistently to maintain a higher position in school work than their intelligence would justify. In all, desire for approval and fear of criticism by teachers were strong motives. This compensated for a general failure to achieve normal relations with contemporaries ; shown in the boys by their being unusually "good" children, and in the girls by a degree of shyness and timidity that made for similar isolation.

In general the attack coincided, in the boys, with the early phases of puberty, when erections and awakened sexual interest coincided with the breakdown of the more passive pattern. In the girls the attack tended to be associated in time with the onset of menstruation. The precipitating factor was surprisingly uniform : in each case it was associated with temporary separation of the child from the mother, parents or home circle.

A prodromal phase of disturbance occurred in all of the cases in the weeks prior to the acute episode, but in two (Cases 2 and 3) this prodromal phase, and indeed the acute episode, were clearly seen as exacerbations of a personality disturbance that had existed for years. The prodromal phase proper lasted for several weeks and showed the features of anxiety—psychic and somatic—of depression and, less frequently, mild excitement.

Anxiety, sometimes intense, was uniformly present in the acute phase of the illness. Depressive characteristics emerged strongly in Case 1, who in his previous personality was a boy of sensibility, warmth and good affective rapport and who in convalescence showed recurrent depressive phases. Case 3, described as warmhearted and popular, similarly showed depressive phases prior to the acute episode ; depression was also strongly present in the illness and convalescence of Case 6. While depressive features may be traced in the other three cases, the excitement, the thought disorder and much of the content had a schizophrenic colouring, particularly in Case 5. Finally, the acute phase supervened in most, subsequent to days or weeks of tension, restlessness and sleeplessness, so a toxi-exhaustive factor could not be excluded from the colouring of the clinical picture. In the post-operative case (3) this element was clear. It was only, however, in the most acute cases (Cases 3 and 5) that an actual loss of sense of time and place occurred.

The content of the acute phase constituted an emergence into consciousness of hitherto unconscious material of so dominating a character that it led to delusions or hallucinatory experiences. It was uniformly found, however, in these cases that affective contact was not lost and that personality disintegration did not occur, so that they remained susceptible to psychotherapy. In retrospect the situation and emergent material were found to explain the illogical content and to demonstrate the mechanisms at work with a completeness seldom met with except in the films. The well retained personality and affective rapport after the acute phase, and the relative simplicity of the connection between the situation and the content, are regarded as characteristic of this group of cases.

The hallucinatory experiences described were recognized by the subject as endogenous. Thus Case 1 said his "thoughts were so vivid they talked to him." Case 6 complained of the "smell of gas," but later said it was "a peculiar feeling as if there were gas about." Similarly, Case 5, in describing her ecstasy-like experience, retained insight to say later "I *thought* I saw ghosts in the church, and the voice of the loudspeaker *seemed* to be saying . . ."

CONCLUSIONS.

In conclusion the authors confirm, on the basis of these cases, that acute psychotic episodes may occur in adolescence, that severe anxiety is characteristically present and a depressive colouring frequent ; that ideas of self-reference of delusional intensity and hallucinatory experiences may be present ; that, nevertheless, disintegration of the personality does not necessarily occur, and good affective rapport may be established after the acute phase ; that the cases may recover spontaneously or ultimately show a very good response to psychotherapy. The psychotic episode is usually determined by marked situational stress in an adolescent undergoing severe psychosexual conflict often related to an undue attachment to the heterosexual parent. They would adhere to the term, " Reactive Psychosis of Adolescence," as used by Kasanin and Kaufman (21) to designate these cases.

The authors wish to express their thanks to the colleagues whose cases provided the material for this study.

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THE EFFECT OF PREFRONTAL LEUCOTOMY ON THE PSYCHOGALVANIC RESPONSE.

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[Received 3 February, 1950.]

Though it is now generally accepted that prefrontal leucotomy has an effect on the subject's behaviour, its mode of action and the intermediate stages of its effect are still obscure. Some evidence, which has been sufficiently reviewed elsewhere (Meyer and McLardy, 1949; Fleming, 1944), suggests that the operation acts by lessening emotional drive: the retrograde degeneration which usually occurs in the dorso-medial and anterior thalamic nuclei points to this. Clinically, however, the belief rests on little more than impressions. In order to obtain more objective evidence, we have used the psychogalvanic response, not because it measures emotional change with fidelity, but because it is one of the few objective tests available. Though its precise relation to emotional change is still not clear, that it does have some relation has been demonstrated repeatedly. We have therefore attempted to compare the sizes of the response before and after the operation.

We would have preferred to perform the test before and after operation on every subject; but as only six could be so tested, we have also examined twenty-one leucotomized patients, comparing them with an equal number of carefully selected controls. Almost every subject was examined at several sessions, and all were tested with a variety of stimuli. As we were interested chiefly in reactions of cortical origin, various "threats" were presented in symbolic form; but direct strong sensory stimulation was also given at each session, partly to reinforce the threats and partly to provide an estimate of the general reactivity at that session.

Apparatus and Method.

The subject's resistance was measured by a Wheatstone bridge, the circuit being arranged as in Fig. 1. By opening switch A, the resistance of the patient's branch could be increased by 500 ohms: the sensitivity of the galvanometer was always adjusted so that the change of 500 ohms caused a deflection of 25 divisions on the galvanometer's scale. The deflections have been recorded uniformly in these divisions: multiplied by 20 they will give the change in ohms. The galvanometer was highly sensitive, requiring only 0·02 micro-amps. per division. It was, however, sufficiently quick in movement to be able to follow with fidelity the comparatively slow changes of the psychogalvanic response.

To avoid polarization, we used large electrodes and the whole surface of the subject's hands. Two jars containing 2 litres each were almost filled with saline (0·85 per cent NaCl), and a large sheet of zinc (area about 200 sq. cm., bent to form a cylinder) was placed in each. The subject's hands were immersed to the wrists in the saline, and the sheets of zinc connected to the bridge. In this way a large, uniform, and unvarying area of electrical contact was maintained. The electro-chemical potential between saline and zinc, being symmetrical, was balanced out. Since some workers (e.g. Richter, 1929; Forbes, 1936) obtained different responses from different areas of skin (e.g. dorsal and palmar surfaces of the hand) our method has the advantage of uniformity in sampling.

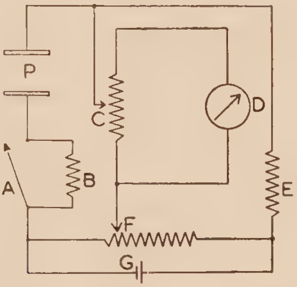

FIG. 1.—Circuit of the Wheatstone bridge used: P, position of subject; A, switch for calibration: usually closed, its opening adds resistance B to the subject's branch; B, 500 ohm resistor; C, potentiometer for adjusting the sensitivity of the mirror galvanometer D; E, 10,000 ohm resistor; F, variable resistor (200 ohms) for balancing the two branches; G, cell of 1·5 volts.

The resistance shown on the bridge is due partly to the subject and partly to the saline; but the effect of the latter is negligible. Sodium chloride at 0·85 per cent. has an equivalent conductivity of 90 (Kaye and Laby, 1942) and a molarity of 0·145; so the specific resistance of the solution is 77 ohms/cm^3. As the distance between hand and electrode is about 5 cm., and as the hand and electrode have each an area of about 200 sq. cm., and as there are two hands, the total resistance due to the solution will be approximately $77 \times 5 \times 2/200$, i.e. about 4 ohms. As the subject's resistance was never below 1,000 ohms, the resistance of the saline never exceeded a two-hundredth of the whole. It is therefore negligible compared with the other factors.

EFFECTS OF TEMPERATURE, HABITUATION, AND POLARIZATION.

The effects of the temperature in the handbath, of the decay in responsiveness commonly found to occur during a session, and of the polarization apt to occur during a session, were studied in a preliminary investigation. (It should be noticed that as habituation and polarization both tend to cause a lessening of the psychogalvanic response as the session progresses, their effects are confounded, and a distinction between them is not easily made. For our purpose, however, the distinction is not necessary: we accept that the response diminishes, for various reasons, during the session, and have so arranged the experiments that this change is allowed for in the subsequent comparisons.)

To find the effects of these factors, three subjects were given each of five stimuli—a pinch to the lobe of the ear, a bright light, the noise of a tin basin falling, the smell of 2 per cent. ammonia, and a light touch on the conjunctiva. These were administered in cyclic order when the hand-bath had each of four temperatures (10°, 20°, 30° and 40° C.).

As the response was obviously non-linear in its relation to time during the session, Ezekiel's graphic method (1930) was used for the analysis of the results. One independent variable (time) was taken, and a curve drawn showing the first regression, that of response on time. The residual deviations from this curve were then used as ordinates for the second regression, that of response on temperature. The residual deviations from this curve were then used to obtain a better approximation for the first regression, and so on. Each improvement in the regressions diminished the residual deviations: the process was continued until they were minimal. Examination of the data gave no evidence that the two regression curves were not independent. The effects of the two factors—time and temperature—were found to be as shown in Fig. 2. The response diminishes as the session proceeds, and increases as the temperature of the hand-bath is raised. These effects had to be eliminated.

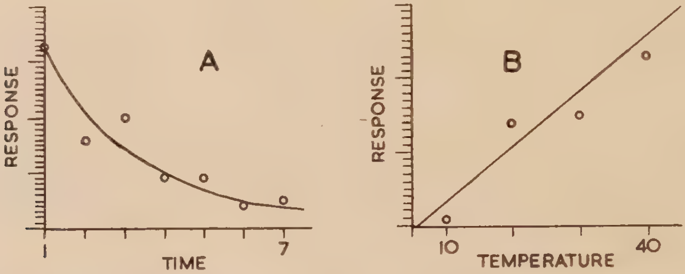

FIG. 2.—Changes in the psychogalvanic response: A, with time during one session; B, with temperature of the hand-bath. Each circle is the average of 7 to 10 observations. The responses are measured on an arbitrary scale.

The effect of temperature was eliminated by keeping the hand-bath always at 37° C. This temperature was chosen partly for the subject's comfort, but especially to obtain greater sensitivity; for, as can be seen in Fig. 2 (B), at the warmer temperature the response is larger. As the slope of the curve is not zero at 37° C., careful regulation of the temperature is essential, for any error appears unaltered in the final results.

The effect of time cannot be eliminated directly: it can only be equalized by taking care that all subjects are treated similarly. This precaution was taken, and should suffice to make any error negligibly small. It will be noticed that our final results are not subject to the full range of variation shown in Fig. 2 (A): each subject's score is the average over all tests given in each session, and no direct comparison is made between the individual tests given at different times within one session; consequently only differential effects will appear—and these are usually small. As the first-given stimulus tends to evoke a particularly large response, and as this excess cannot be reduced, we have used Fisher's principle (1935), equalizing the effect by presenting the stimuli in randomized order so that every stimulus has an equal chance of being given first. That the randomization should be adequate, we used the tables of Fisher and Yates (1938).

THE TESTS.

For the examination of our subjects we used eight stimuli. Four were real, direct, and strong: the smell of 2 per cent. ammonia; a pinch to the lobe of the ear by a spring clip which applied the same pressure on all applications; a brilliant illumination of the eyes by a "Photoflood" lamp; and a touch with a wisp of cotton wool on the conjunctiva. The variety of tests was used to reduce personal idiosyncrasies. These four stimuli almost always elicited a brisk psychogalvanic response. In addition the four stimuli were administered not actually but as a threat, i.e. in "symbolic" form; thus, the dish with the ammonia was brought near to the subject's nose but not uncovered, the lobe of the ear and conjunctiva were approached but not touched, and the lamp was exhibited but not switched on. Before each stimulus was given, the subject was told briefly what to expect, but no hint was given whether the stimulus would be real or threatened.

THE SUBJECTS.

The first group consisted of twenty-one patients who had undergone prefrontal leucotomy. Eleven were men and ten were women. Their average age was 46 years, and the average interval since operation 3·4 years. Eight men and two women were still resident in hospital: the others had recovered sufficiently to return home. At the time of operation, ten had been considered schizophrenic, six melancholic, and there were five others.

To act as controls, a second group was assembled; it was composed of the same number of psychotic patients selected to match the first group as closely as possible. There were thirteen men and eight women, of average age 47. Eight were schizophrenic, seven melancholic, and there were six others. (That this group was well matched to the other is supported by the fact that, since the completion of the experiment, prefrontal leucotomy has been recommended for six of them).

A third group was composed of six patients whom it was possible to examine both before and after operation. Though small in numbers, this group could act as its own control, and offered the advantage of a properly designed factorial experiment. It therefore provides information of peculiar value. Of the subjects, four were women, two men; three were melancholic, three schizophrenic; their ages lay between 19 and 74 years. In this group all tests were conducted within six months of the operation.

A factor of possible significance is the route of entry used: lateral or transorbital. Of the six patients in the last-mentioned group, four had been entered by the transorbital route. The other two, and the twenty-one in the first group, were entered by the lateral route.

THE EXPERIMENT.

The events in one session have been described above. Each session yielded two scores: the sum of the four responses to the real stimuli, and the sum of the four responses to the threatened. Division by four gives the average response.

Each of the six patients was tested on 3 sessions before and 3 sessions after the operation: a total of 288 responses. The analysis of the results is given below.

The two groups of twenty-one patients could not, for reasons outside our control, be studied so systematically, and the orthogonality of the factors is imperfect. The defect, however, is only partial and, as will be seen, there is reason to believe that the relations between the factors are simple so that a slight lack of orthogonality is of little consequence. The defect is due chiefly to the fact that not all patients could be tested over the same number of sessions. But within each session the conditions and methods were uniform, and this uniformity was maintained over the whole study.

The leucotomized patients were studied at 57 sessions (456 psychogalvanic responses), and the controls at 73 sessions (584 responses). As the study of the six patients was completely orthogonal it has been kept separate. To some degree the two studies complement each other: a larger but less accurate study contrasts with one smaller but more precise.

THE EFFECT OF "FAMILIARITY."

A minor effect, but one which had to be considered, was the tendency for each patient, as he became accustomed to the routine of the tests, to react less. The "habituation" described earlier showed only within each session; here we are discussing the change which tended to occur as session followed session. Not only is this change a source of variance, but, much more important, it would tend to be confounded with the effect of leucotomy. We shall refer to it as "familiarity."

Its size can be estimated from the two groups of twenty-one patients, for each patient would show, as session succeeded session, the effect of this factor alone. We have therefore fitted a straight-line regression curve to each of the four groups of results in the leucotomized and non-leucotomized groups subdivided into responses to real and to threatened stimuli. (There was no evidence that the regression differed significantly from the linear.) The effect was found to be small. In no group was the regression statistically significant, but all were of the expected sign (Table I).

TABLE I.—*Regression coefficients of psychogalvanic response on session number, in four groups.*

Group.		Number of tests.	Regression co-efficient.
Patients.	Stimuli.		
Non-leucotomized	Real	228	—0·679
,,	Threatened	228	—0·711
Leucotomized	Real	292	—1·235
,,	Threatened	292	—0·893

The average of all four groups, however, differed significantly from zero ($P = 0{\cdot}01$). The effect of familiarity is therefore demonstrable in our results.

The average value of the fall was 0·88 divisions (i.e. 17·6 ohms) per session. This quantity has been added to all the scores discussed below. The correction, though worth while, is not large.

EXPERIMENTAL RESULTS.

The presentation of our results is best commenced by the elimination of some factors which were found to have no significant effect on the patients' responses.

One such factor is the distinction in the leucotomized group between those patients who improved and those who did not. Of the twenty-one leucotomized patients, those who "improved" numbered eleven: three men and eight women. Their average age was 46 years, and the average interval since leucotomy three years. At the time of their examination, seven were in their normal employment: in business or in the home. (One subject was living at home at the time of examination, but has returned to hospital since.) The other three were leucotomized recently (average interval three months). Those who were "unimproved" numbered ten: eight men and two women. Their average age was 45 years, and the average interval since leucotomy four years. None had improved sufficiently to be discharged. The two groups were distinguished by a purely clinical criterion, the main question being whether they improved sufficiently to leave hospital. Though the mode of distinction is crude, our present knowledge can hardly suggest a better: the distinction is probably sufficient for practical purposes. The mean responses of the improved and of the unimproved, and the difference with its standard deviation, are shown in Table II.

TABLE II.—*Mean scores of psychogalvanic responses in the two groups "Improved" and "Not-Improved," and the standard deviation of their difference. Responses to real stimuli and to threatened are shown separately. (In units of* 20 *ohms).*

Type of stimulus.	Group.	Number of tests.	Mean score.	Difference.	S.D. (diff.).
Real	Improved	76	26·6	4·0	±5·4
,,	Not improved	152	22·6		
Threatened	Improved	76	14·7	0·4	±4·5
,,	Not improved	152	15·1		

The responses to real and to threatened stimuli are shown separately. Neither difference exceeds twice its standard deviation; so there is no evidence that the responses of the leucotomized patients are dependent on the degree of clinical improvement.

The 456 observations on the leucotomized patients can now be compared with the 584 on the controls. In the two groups the mean responses are 19·5 and 25·2 divisions respectively; the difference is 5·7 with standard deviation

2·4. The difference is 2·3 times its standard deviation, and P is 0·02. This difference (5·7) is derived from measurements over two groups: the real and the threatened stimuli. It is advisable to see whether these two groups agree in their estimates of this difference. Any disagreement would represent a statistical interaction between the two factors, "operational status" and "type of stimulus." Its presence is tested by finding the value of the linear function

$$w - x - y + z,$$

where the quantities are the mean responses in the groups

w,	leucotomized patients,	real stimuli.
x,	,, ,,	threatened ,,
y,	non-leucotomized ,,	real ,,
z,	,, ,, ,,	threatened ,,

and by comparing its value with its standard deviation. The function has the value −6·0, and its standard deviation is 4·8. As the effect does not exceed twice its standard deviation it must be judged insignificant. There is therefore no evidence that the two types of stimuli are affected differentially by the operation.

The conclusion is confirmed by the evidence presented in Table III, which shows the results of the patients who were examined at 3 sessions before operation and at 3 sessions after.

TABLE III.—*Psychogalvanic responses of patients each tested on three sessions before and on three sessions after prefrontal leucotomy. Each number is the sum of four individual tests. Each pair refers to one session, the upper number giving the response to real stimuli, the lower to threatened. In units of 20 ohms*).

Patient.	Before operation.			After operation.		
1	52	92	73	28	39	13
	20	23	40	19	32	9
2	12	30	12	18	13	15
	0	34	6	8	7	8
3	9	4	19	16	32	37
	7	9	10	27	17	21
4	16	33	55	61	102	60
	5	26	35	22	57	36
5	17	43	93	49	81	70
	5	33	44	20	40	30
6	24	22	23	6	29	14
	20	64	42	4	15	7

In Table IV is given its analysis of variance.

TABLE IV. *Analysis of variance of the observations in Table* III. *The capitals in the first column indicate two- and three-factor interactions.*

Variance.	D.F.	Sum sq.	Mean sq.	Var. ratio	P.	Sig.
Operation (A)	1	1·39	1·4	0·0	>0·2	O (1)
Type of stimulus (B)	1	3,612·50	3,612·5	41·2	<0·001	** (2)
AB	1	133·39	133·4	1·5	>0·2	O (3)
Patients (C)	5	10,432·44	2,086·5	23·8	<0·001	** (4)
CA	5	6,693·44	1,338·7	15·3	<0·001	** (5)
CB	5	3,137·00	627·4	7·2	<0·001	** (6)
CAB	5	2,041·11	408·2	4·7	<0·01	** (7)
Sessions (S)	24	9,720·33	405·0	4·6	<0·001	** (8)
SB	24	2,057·00	87·7	—	—	—
Total	71	37,828·60	—	—	—	—

** = significant at 1 per cent. level.
* = significant at 5 per cent. level.
O = not significant at 5 per cent. level.

We may first notice that the interaction between "operational status" and "type of stimulus" is insignificant (at (3) in the right-hand column of Table IV), confirming what was found in the previous groups.

Turning to Table III, we find suggestions that the patients are not equally affected by operation. The response of Patient 6, for instance, seems to be diminished after operation, while that of Patient 3 seems to be increased. The impression is confirmed by (5) in Table IV, which shows that the interaction between "patient" and "operational status" is significant with P less than 0·001. The changes in the patients' responses, following operation, are therefore not consistent, but show individual peculiarities.

These six patients show no general trend in the change induced by operation ((1) in Table IV), contrary to what was found in the two previous groups. The interpretation, however, seems clear. The fact, shown above, that patients react to the operation with individual peculiarity, some becoming more and some becoming less responsive, means that in any group the average result will depend chiefly on the particular sample of patients taken. With this major source of variability present the general average change becomes of less interest.

The results can also be analysed in a slightly different way. The experiment was arranged so that every stimulus given as a threat was also applied in real form at the same session. Inspection of the results in Table III shows that the two responses are correlated ; so one of them can be used as an estimate of the patient's responsiveness at that session, and the effect of day-to-day variation in responsiveness can thus be eliminated from the results. This has been done by Fisher's method of the analysis of covariance. The results are given in Table V.

TABLE V.—*Analysis of covariance of response to threat, response to real stimuli being used as concomitant variable.*

Variance.	D.F.	Sums of squares and products.				D.F.	Mean sq.
		Threat.	Real.	Product.	Adjusted.		
Operation (A)	1	54	81	− 66	141·88	1	142
Patients (C)	5	1,825	11,745	+3,648	—	—	—
AC	5	2,414	6,321	+2,326	—	—	—
Sessions	24	4,349	7,428	+3,832	2,372·80	23	103
Total	35	8,641	25,575	+9,740	2,514·68	24	—

Variance ratio = 1·38 ; $P > 0{\cdot}2$.

The sums of squares and products between sessions were found by direct computation from each pair of degrees of freedom ; so that the equality of each total of four items with the total found over all 36 observations establishes the correctness of the arithmetical and algebraic processes. The variance ratio is 1·38, and *P* is more than 0·2. It follows that the effect of operation on the response to *threatened* stimuli, allowance being made for variations in the responsiveness at different sessions, is insignificant.

DISCUSSION.

The significance of these results will be better appreciated after a brief review of the anatomical basis of the psychogalvanic response and its possible relation to leucotomy.

The main structures activated in the psychogalvanic response are now known, though many details remain to be discovered. The fact that the response can be elicited by complex and symbolic stimuli shows that these structures can be reached from any part of the cerebral cortex. Langworthy and Richter (1930) found that in the cat the point of departure from the cerebral cortex lay in two particular areas : one lying in the premotor region (area 6) and the other lying in the anterior part of the temporal lobe. Stimulation of these areas caused a conspicuous fall in the electrical resistance of the skin, the effect being most marked contralaterally. By stimulating deeply, they followed the conducting fibres and found them to travel not by the pyramidal but by the fronto-pontine and temporo-pontine fasciculi. This work was confirmed by Schwartz (1937) who, having shown in the cat that total decortication abolished the psychogalvanic response, found by partial decortication that, however much cortex was removed, the response was retained if area 6 was retained, and that the ablation of area 6, however little else was removed, always abolished the response. When the ablation was unilateral, the response was lost on the contralateral, but preserved on the ipsilateral side. Wang and Lu (1930) confirmed Langworthy's results and found that a " galvanic " response of similar characteristics could be elicited by stimulation of the hypothalamus. As destruction of the hypothalamus did not abolish the response to cortical stimulation, they concluded that the two "centres" used separate extrapyramidal pathways.

Though the response is believed by Goadby and Goadby (1949) to be mediated through centres in the midbrain, little is known about these. Nor are the tracts of descent in the spinal cord known, though it has been shown (Bolton, Carmichael and Stirrup, 1936; Gilliat, 1948) that the impulses determining resistance and potential descend by the same tracts as those whose effects are recorded by the finger-plethysmograph, effects shown by Golla (1921) to have a latent period and form of curve identical with those of the psychogalvanic response. The impulses certainly traverse the sympathetic ganglia: both cervical and lumbar sympathectomy abolish almost completely the psychogalvanic response in the operated limb (Goadby and Goadby, 1949). The sympathetic chain, too, must carry some impulses, for the same workers found, in a patient with paraplegia, that a complete transverse lesion of the spinal cord at the eighth dorsal segment, proved by laminectomy, failed to cause any difference between the psychogalvanic responses in the upper unparalysed and in the lower completely paralysed limbs.

In the limbs themselves the impulses are conveyed by the peripheral nerves: perineural injection of procaine completely abolishes the response over the area of skin supplied by a nerve.

In the tissues the changes are complex and are probably not fully known. There is no doubt that changes in the activities of the sweat glands are of major importance (Darrow 1942; Carmichael, Honeyman, Kolb and Stewart, 1941), and it was shown by Golla in 1921 that most of the changes in resistance take place in the superficial layers of the epidermis. Goadby and Goadby (1949) have shown that the changes in potential and in resistance cannot be due to the same mechanism, for complete exsanguination, by an Esmarch's bandage, totally abolishes the change of resistance while leaving that of potential unrestrained.

The adequacy of our own method, measuring resistance, is supported by most workers, who find that the several ways of recording the peripheral changes tend to be equivalent.

From these facts it will be evident that only a provisional comparison can be made between those white-matter fibres which may be responsible for the psychogalvanic response and those fibres which may be cut in prefrontal leucotomy. Meyer and McLardy (1949) have emphasized the variability of the anatomical positions of the cuts made, and this uncertainty must increase the difficulty of deduction. Such evidence as there is, however suggests that prefrontal leucotomy, whether done by the lateral or transorbital route, will seldom injure directly the fibres responsible for the psychogalvanic response: the fronto-pontine fibres will usually lie too low and the temporo-pontine too posteriorly. Though the human homologue of the cat's area 6 is uncertain, the cortical areas in man known to have autonomic function (the posterior orbital and the anterior cingular) are not likely to be damaged in leucotomy, except occasionally.

This being so, changes in the amplitude of the psychogalvanic response after leucotomy may reasonably be attributed to changes in the patient's "emotional responsiveness," by this being meant changes occurring in the other channels, e.g. thalamus and hypothalamus, through which the cortex can influence the peripheral mechanisms.

The interpretation of our results from this point of view is somewhat complex. The set of patients tested both before and after operation showed no uniform change, but did show that the patients varied among themselves, some increasing and some decreasing in responsiveness after operation. The group of forty-two patients, twenty-one operated and twenty-one controls, showed that on the average there was a small but significant fall in responsiveness (from 25·2 to 19·5 units). The difference between the result from the six patients and that from the forty-two cannot be accounted for with certainty. Most probably it has occurred because the effect of the leucotomy is small, one of the experiments just failing to show it and the other just succeeding. That it is partly irrelevant to the main effect of leucotomy is shown by the fact that when the leucotomized patients are divided into the "improved" and the "unimproved," corresponding, presumably, to those who do and those who do not show the main effect of leucotomy, the difference, instead of appearing more clearly, disappears. In fact, when real stimuli are used, the "improved" group actually responds more actively than the "unimproved" (Table II): a change in the opposite direction to that considered here.

Our general conclusion, then, must be that our results show that there is no major uniform change in the size of the psychogalvanic response after leucotomy. Especially should it be noticed that the response to threat, i.e. to a symbolic stimulus, shows no alteration.

SUMMARY.

To test the effect of prefrontal leucotomy on emotional drive we have tested the effect of the operation on the psychogalvanic response.

A group of leucotomized patients was compared with a similar group of psychotics; and some patients were studied both before and after operation. At each session four stimuli were used, and each was presented once in real and once in symbolic form. Almost every patient was tested at several sessions.

The patients showed clear evidence of individual peculiarities in their change of responsiveness after operation; but there was little evidence that any uniform trend existed. Stimuli given in symbolic form retained their power of evoking the response.

These results do not support the suggestion that prefrontal leucotomy diminishes emotional drive.

ACKNOWLEDGMENT.

We should like to thank Professor F. L. Golla for his advice and interest throughout the investigation.

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A CASE OF PERIARTERITIS NODOSA OF THE CENTRAL NERVOUS SYSTEM.

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This is a clinical and pathological report on an unusual case of periarteritis nodosa in which the disease was confined chiefly to the brain and spinal cord. The diffuseness, variability and intermittency of the neurological signs and symptoms over a period of two years, in the absence of many of the more usual somatic manifestations of periarteritis nodosa, was responsible for the nature of the disorder not being diagnosed before death. Mental symptoms were prominent throughout the last year of illness. T.A.B. pyrexial therapy coincided with a marked remission in physical and mental symptoms, whilst arsenical therapy appeared to precipitate the terminal exacerbation of symptoms.

Case History.

C. H—, a man born in 1892, had a medical history of chronic catarrh of the upper respiratory tract, development of deafness in the left ear in 1937, and jaundice in 1940. It is not certain whether or not sulpha drugs were given for any of these conditions. During 1944, in his 51st year, he began to experience occasional attacks of stabbing pain in the left side of his face, accompanied by pyrexia. In February, 1946, he developed an atypical left trigeminal neuralgia after an attack of influenza with pyrexia. This was relieved by injection of the Gasserian ganglion with alcohol, but was soon followed by a new set of symptoms. He developed an intermittent temperature of up to 100° F., with stabbing pains in the back of the neck followed some weeks later, in early March, 1946, by vomiting and giddiness. He was examined by a neurologist, who found rotary nystagmus on looking to the right and analgesia over the first and second divisions of the left fifth cranial nerve. The C.S.F. showed 110 cells per c.mm. (polymorphs 24 per cent., lymphocytes 76 per cent.) and 80 mgm. of protein per 100 c.c. There was inability to distinguish heat and cold over the skin of the right leg with a relative analgesia and anaesthesia below the level of the ninth dorsal segment on the right side.

By May, 1946, the patient was complaining of diplopia, due to a partial palsy of the right third cranial nerve, with weakness of the right hand and right lower limb and attacks of painful cramp. The C.S.F. showed 70 cells per c,mm. (16 per cent. polymorphs, 84 per cent. lymphocytes), and 100 mgm. protein per 100 c.c. The Kahn and Wassermann tests were negative. In June he was given a course of penicillin which made no impression upon his physical condition. From September to December, 1946, he had occasional rises of temperature to 100° F. with giddiness and unsteady gait, and by December was beginning to complain of insomnia, depression and difficulty in concentration. He was very restless and unduly agitated over money matters. At this stage neurological examination revealed : right pupil slightly larger than the left one; left-sided ptosis, anaesthesia over the first and second trigeminal areas on the left side; slight weakness of left facial movement, tongue protrusion slightly to the right, marked slurring, dysarthria and a diminution in muscle tone and weakness in the right arm and leg. There was impairment of postural sensation on the right side with extreme tenderness on pressure over the cervical nerve roots. The tendon reflexes in the right arm were brisk and in the left arm absent. The left abdominal reflexes were unobtainable, but the right ones were present. The knee and ankle jerks were brisk, the right plantar reflex extensor. Sensory testing was unsatisfactory because of his drowsy condition. About a month later his mental state began to deteriorate more rapidly and he became confused, disorientated and deluded; speech became incoherent and his conduct mildly manic. The C.S.F. was under normal pressure but contained an excess of lymphocytes.

On admission to Holloway Sanatorium on 12, March 1947, he was restless and unpredictable in his conduct, getting out of bed and refusing all food. His conversation was almost unintelligible and he could not give coherent replies to even the simplest questions. There was generalized muscular weakness and complete inability to fend for himself. He had gradually become bedridden and dirty in his habits. The erythrocyte sedimentation rate was 25 mm. in one hour, haemoglobin 92 per cent. (Haldane), and total red cell count 4·15 millions per c.mm., total white cell count 7,200 per c.mm. (polymorphs 69 per cent., eosinophils 1 per cent.). The Kahn reaction was negative, the blood pressure 150/100. The urine contained no abnormal constituents. The C.S.F. was not under increased pressure, but contained 52 lymphocytes per cmm., a total protein of 60 mgm. per 100 c.c. and gave a Lange curve of 1122100000.

A purely descriptive diagnosis of "confusional syndrome with extensive neurological complications" was made. The condition was thought by the consulting neurologist to be an unusual form of relapsing encephalomyelitis due to a virus or torula organism.

As there was no obvious specific form of treatment a course of non-specific protein therapy (Parfitt, 1938) was started on March 24, 1947, four million T.A.B. vaccine bacilli being given intravenously on the first occasion and the dose doubled at each subsequent injection. Treatment was given twice a week for two months, producing pyrexias in the earlier stages up to 103° F. By the end of this period the patient's mental condition showed a definite improvement; he was cleaner in his habits, had greater emotional control and, although ataxic, was up and about, fully dressed, and enjoyed the radio and reading. He was orientated for time and place, recognized and conversed with his relations and made enquiries about their welfare. A further C.S.F. examination revealed that the cells had dropped to 3 lymphocytes per c.mm., the total protein to 40 mgm. per 100 c.c. and the Lange curve to 0000000000. The duration of this period of improvement was about five weeks.

On 2 June, 1947, his treatment was changed, after eight days interval, to biweekly injections of neo-arsphenamine. This was done because T.A.B. vaccine was now failing to produce any appreciable pyrexia. Three weeks later he developed an itchy urticarial rash on both arms. This coincided with the beginning of rapid general physical and mental relapse and progressive deterioration. After two weeks' respite all injections were stopped on 4 July, 1947. By that date the total protein in his C.S.F. had risen to 90 mgm. per 100 c.c., the colloidal gold test was still entirely negative, and his condition was becoming extremely grave. On 30 July, 1947, his wife decided to take him home, and he died five months later, on 25 November, 1947, aged 55, after several "fits," followed by paralysis and coma, which his home doctor considered were due to sudden obliteration of large cerebral arteries.

Pathological Report.

At autopsy no abnormality, and in particular no infarct, was observed in any of the general organs or in the uncut brain and spinal cord, but examination after fixation revealed small nodules, just visible to the naked eye. along the course of several medium-sized arteries, particularly the anterior spinal artery. Only the brain, spinal cord, pituitary and spleen were preserved for further investigation.

Coronal sectioning of the brain showed both lateral ventricles slightly dilated and cystic softening in the anterior limb and genu of each internal capsule (Fig. 1). There was no evidence of petechial, or larger, haemorrhages.

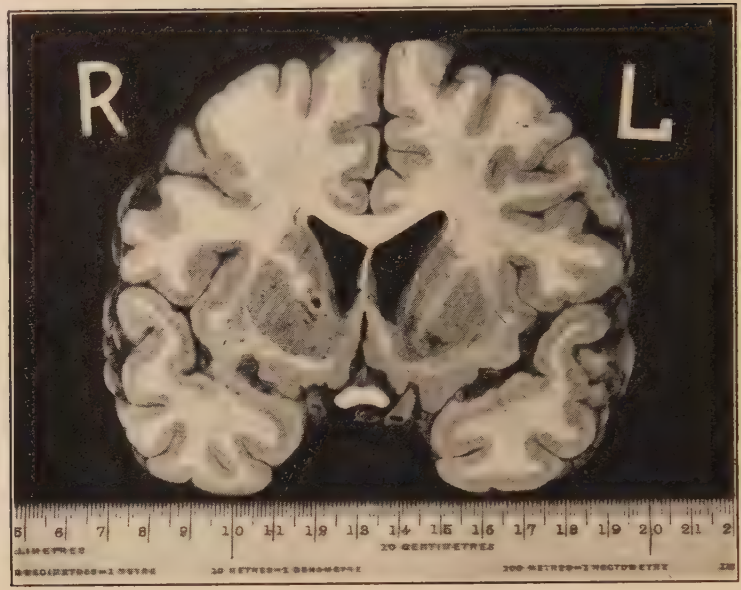

Fig. 1.—Coronal section showing cystic softening in the internal capsule in each hemisphere.

Histological investigation revealed striking changes in medium-sized and small arteries especially at the base of the brain and around the spinal cord. In the interpeduncular fossa of the midbrain the posterior perforating arteries were surrounded by a mass of necrotic tissue (Fig. 2). This was made up of nuclear debris and contained no caseation, no giant cells and (on repeated examination) no tubercle bacilli. Many of the arteries displayed severe necrosis of the media and infiltration of the whole wall of the vessel by lymphocytes and fibroblasts, but no eosiniphils or giant cells. The elastica interna was split and broken in places. The intima was necrosed to a lesser degree than the media and was occasionally proliferated, causing reduction in the lumen of some of the affected vessels, but seldom to the extent of complete obliteration. The adventitia was heavily proliferated and infiltrated by lymphocytes (Fig. 3). Evidence of old recanalized thrombosis of the lumen was observed within the most conspicuous nodule on the anterior spinal artery. One aneurysmal dilatation was noted close to the origin of the left middle cerebral artery. Not all the arteries in an affected region displayed these changes, for instance, around the periphery of any given level of the cord. Another feature was that as the same vessel was followed upwards or downwards in serial sections the pathological changes came and went.

The subarachnoid space contained collections of lymphocytes and plasma cells, especially over the base of the brain and around the cord. The cerebral cortex displayed no noteworthy histological abnormality beyond chromatolysis of about one-third of the Betz cells (presumably due to retrograde degeneration from the softening in the internal capsules). The basal ganglia, internal capsule and thalamus, on the other hand, exhibited softenings (white infarcts) of various sizes and ages, roughly symmetrical in the two hemispheres. The ganglionic arteries in and around these regions showed all stages of occlusion and cuffing with lymphocytes and plasma cells. Similar but more irregular areas of softening were scattered throughout the medulla and the tegmentum of the midbrain and pons. Both temporopontile tracts were heavily gliosed. The Purkinje cells of the cerebellum displayed homogenizing necrosis over wide areas. Within the cord pathological small arteries and early softening were apparent especially in the lateral white columns at lower thoracic levels and the fasciculi involved were degenerating. Some of the vasa nervorum of both anterior and posterior nerve roots showed the periarteritic changes, especially at lumbar levels. Vessels of

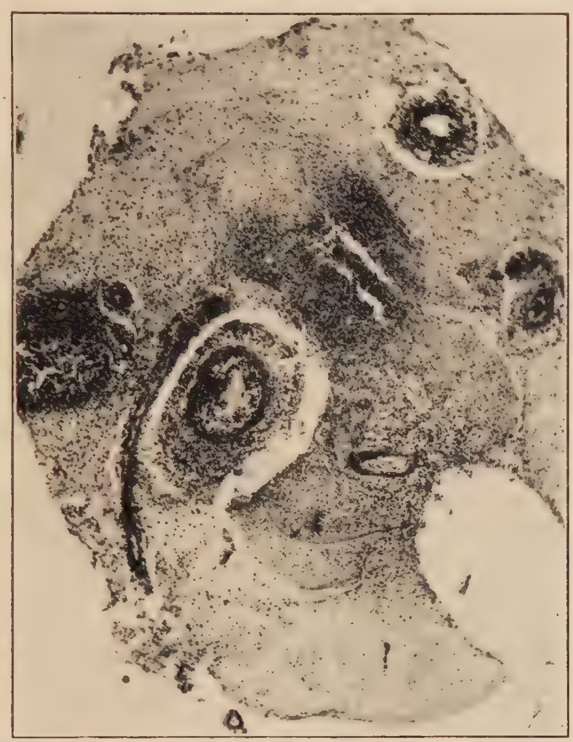

FIG. 2.—Posterior ganglionic arteries in the interpeduncular fossa, showing inflammatory changes typical of periarteritis nodosa (H. and E. × 65).

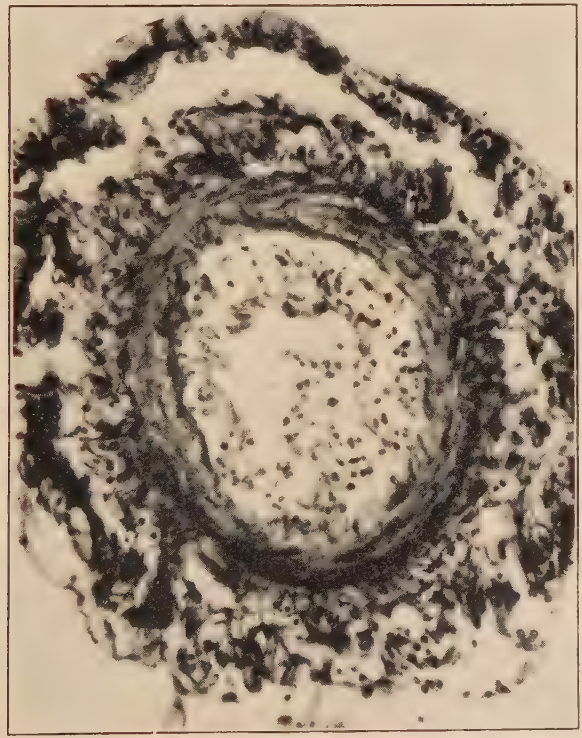

FIG. 3.—Higher power view of a section of the anterior spinal artery, showing the destruction of media, the proliferation of adventitia and intima, and the infiltration by lymphocytes. (H. and E. × 250.)

the pituitary and of the spleen showed no such changes. There were no amyloid changes in the spleen.

DISCUSSION.

There would seem no reasonable doubt that the condition is one of uncomplicated periarteritis nodosa. The primary (arterial) and secondary (infarctual) pathological appearances are typical of periarteritis nodosa in every detail (Kernohan and Woltman, 1938 ; Malamud and Foster, 1942 ; Miller and Daley, 1946). Syphilis and tuberculosis can be excluded on serological and bacteriological as well as histological grounds. Thromboangeitis obliterans affecting the brain (Davis and Perret, 1946/7) cannot be confused pathologically, although it may produce a similar mental picture (Perk, 1947). Temporal arteritis appears to be confined to individuals over the age of 55, has a good prognosis apart from its effects on vision, and is generally characterized by multinuclear giant cells within the necrotic media (Cooke *et al.*, 1946 ; Crosby and Wadsworth, 1948 ; Miller, 1949). On the clinical side, the initial symptoms, the fluctuating location of lesions, their remittances, the mild pyrexia especially during exacerbations, and the over-all gradual deterioration, are typical general features of periarteritis nodosa. There were, however, no manifestations related to the organs most commonly affected by the disease ; no " nephritic syndrome," no tachycardia disproportionate to temperature, no polymorphic leucocytosis or eosinophilia, no skin or muscle nodules. This accords with the macroscopic autopsy findings.

A persistent low luetic form of Lange colloidal gold curve in the C.S.F., in the absence of any other serological reaction related to syphilis, was recorded in the personal case described by Malamud and Foster ; persistent high total protein and lymphocyte cell-count in the C.S.F. had previously been commented upon in the literature.

Involvement of the central nervous system, previously variously estimated to have occurred in from 8 per cent. to 20 per cent. of cases of periarteritis nodosa described in the literature, was found early in the symptomatology in 7 of 16 fatal cases investigated by Parker and Kernohan (1949). Four of these seven had cerebral involvement ; two had been diagnosed as cases of multiple cerebral abscess, one as a rapidly growing glioma and the fourth as a case of cerebral arteriosclerosis.

The aetiology of periarteritis nodosa was for long obscure. Kernohan and Woltman and Malamud and Foster emphasized the inflammatory appearances of arterial lesions. Considerable experimental evidence has been accumulated since the pioneering work of Rich and Gregory (1942) to indicate that allergy plays a big part in the aetiology. Owing to the frequency with which specific bacterial infections, as well as nonspecific minor respiratory infections, antecede the illness, the antigen has been suspected to be bacterial in origin. Miller and Daley, however, after a well balanced review of the clinical and experimental evidence, like many other recent investigators, favour the view that the condition represents a non-specific hypersensitive reaction of anaphylactic type to a variety of antigens. They consider that there is much evidence that the changes in the blood vessels differ only in degree from the less severe acute arteritis seen in acute rheumatism. These changes Miller (1949) conceives of as due to the repeated whealing of chronic recurrent urticaria of the blood vessels leading ultimately to multiple focal necrosis of their walls. Among other clinical evidence in support of allergic pathogenesis is Rosenak and Maschmeyer's (1945) and Black-Schaffer's (1945) description of cases of periarteritis nodosa apparently determined by a hypersensitivity to sulpha drugs; and Miller and Nelson's (1945) and Turner and Paterson's (1946) reports, each of one case, of periarteritis nodosa where the onset seemed clearly attributable to the exhibition of antisyphilitic arsenical drugs. In this connection it is of interest that arsenic has been employed as a form of treatment for periarteritis nodosa (Kernohan and Woltman).

Whether in the present case arsenical (or sulpha) drugs had been administered to the patient before the onset of his neurological illness is not known, but certainly the neo-arsphenamine injections 18 months later seemed to accelerate his physical and mental deterioration. The writers can find no record that pyrexial therapy has ever before been reported to appear to benefit periarteritis nodosa of the central nervous system.

SUMMARY.

The clinical and pathological findings are described in a fatal case of periarteritis nodosa confined largely to the central nervous system and associated throughout the last year of life with conspicuous mental symptoms. The diffuse, variable, intermitting, almost purely neurological signs and symptoms defied correct clinical diagnosis throughout an illness of two years' duration. The cerebrospinal fluid displayed an abnormal amount of total proteins, increased lymphocytes and a low luetic type of colloidal gold curve. A striking remission in the physical, serological and mental state of the patient coincided with a two months' course of pyretotherapy by means of T.A.B. vaccine, whereas a very sudden relapse and progressive deterioration coincided with the occurrence of urticaria during a course of injections of neo-arsphenamine.

ACKNOWLEDGMENTS.

The authors are indebted to Dr. D. N. Parfitt for permission to publish the case and to Professor Alfred Meyer for his criticism of the pathological evidence.

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ACTIVE IMAGINATION DURING THE USE OF THE RORSCHACH METHOD.*

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The Stimulation of Imagination.

The Rorschach personality test is based on the stirrings of imagination. The interpretation of the structureless inkblots by the tested person stimulates his imagination in such a way that he projects his inner thoughts into the responses. Imagination is not merely one of the functions of a personality, but it is an expression of the personality as a whole. Medieval thinkers have described this by calling imagination "the star of man," by which they meant the essence of his personality. This is the reason why the Rorschach method is a valid test for the assessing of personality.

The Rorschach test, as is commonly known, uses the technique of verbal interpretation of inkblots. The person is asked to say what the inkblots might be. Imagination is especially stimulated through artistic creativeness, and on this phenomenon is based a Rorschach technique which uses paintings of Rorschach responses. The patients are asked to draw or paint what they have imagined. The ability to produce imaginative paintings is particularly great in children. According to Cizek this gift is most highly developed in children below the age of 10 years. Towards adolescence a decline of imagination usually sets in and the artistic gift is often lost in adulthood. Because of the artistic phase in childhood the technique of paintings of Rorschach responses yields particularly fascinating results in psychiatric work with children. One of the reasons why this is so lies in the fact, which was emphasized by Cizek and Viola, that the child wants to paint because he wants to tell a story. This is exactly what the psychotherapist is most interested in.

The technique of paintings of Rorschach responses should be applied after the performance of the usual Rorschach test. It consists in a number of procedures. The technique which should usually be applied at first is the production of a painting on a tracing. A tracing of the outlines of the blot is given to the child and he is asked to paint on the tracing where he saw the image and what he saw. Surprising and fascinating paintings are often obtained in this way. Frequently they give additional and unexpected information about the exact locations and determinants and represent excellent starting points for analytical exploration. They also reveal, especially on comparative studies of paintings of different children, a number of mental mechanisms which give new insight into the process of imaginative creativeness.

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* Paper read at the Meeting of the Child Psychiatry Section of the R.M.P.A. on 3 November, 1949.

The richness of imaginative material gained by tracings can be further increased by a technique which uses the phenomenon of "active imagination." The card is removed and a blank sheet is given to the child, who is asked: "Now paint what you saw—just as you like it."

THE MEANING OF "ACTIVE IMAGINATION."

"Active imagination" is a phenomenon related to free association. It was described by Jung and plays an important role in analytic psychological practice.

According to G. Adler one understands by active imagination "a definite attitude towards the contents of the unconscious. It is an attitude which can be best described as one of 'active passivity.' That is, one keeps completely passive and receptive to what is going to emerge from one's own unconscious, but at the same time focusses one's attention actively on what is going to happen. The emerging images show a certain autonomous life and movement. On concentration they can develop and acquire added characters, can form the nucleus for a group of other contents of the unconscious which gather round them. These processes are a spontaneous self-development of the original image and not artificial products intentionally invented. This is shown by the convincing sense of self-evident reality which active imagination conveys to the persons who experience it and also by the autonomy which they possess. This autonomy is most surprising. One finds very frequently that things happen contrary to everything one expected."

In a similar way Baynes described the process, which he called "active phantasying." He emphasized that during the development of spontaneous imagery, "some idea suddenly becomes commandingly relevant and that there is an astonishing certainty of aim." He also said that "the ideal condition for active phantasying is that of the child, as the work of psychological creation is essentially creative play, wherein the child and the man are again united."

Fordham said that "if a person simply lets his imagination work on his own and the correct time has been chosen to do this there follows a phantasy or series of imaginative events, either in the form of a drama in which the patient takes part as one of the figures and in which actions occur and conversations go on, or in that of a dance, or of a vision, The process can also be expressed through the media of painting, carving wood or modelling clay."

Frances Wickes pointed out that "into phantasy a conscious element enters—that is, a concentration upon the image so that it does not disappear again into the unconscious." She also mentioned that during "active phantasying we turn our attention to the inner world, and thereby energize the original image. The appearing figures have a life of their own, disconnected from our daily life and experience, and they behave in ways quite at variance with ours."

Summarizing, one can say:

1. Active imagination is an attitude which has two qualities: receptivity towards the content of the unconscious and conscious active concentration upon these contents.

2. Active imagination is characterized by the emergence of a commandingly relevant leading idea which gives the process direction and aim.

3. Active imagination is a process of focussing on an idea. It forms a nucleus for a group of other ideas which spontaneously gather or crystallize round it.

4. Active imagination is a phenomenon which possesses a certain autonomous life. Things frequently happen contrary to what one expected, and may be disconnected with our daily life.

5. Active imagination conveys a sense of self-evident reality to the person who experiences it.

6. Active imagination can, for instance, be expressed by telling a story, painting or drawing, modelling or carving, dancing or acting.

By asking the child to paint his Rorschach response " just as he likes it " a powerful stimulus is given to him for the development of active imagination. The original image is enriched and often new figures and ideas are created around it. Usually the difference between the child's painting on the tracing and from imagination is considerable. Sometimes, however, the painting on the tracing contains already very rich imaginative material and occasionally the child produces only little new material on painting from free imagination. The value of the paintings lies in two directions. Firstly, they often reveal much analytical material, and secondly they give opportunity to study mental mechanisms of artistic creativeness.

EXAMPLES.

The use of active imagination for analytical exploration will be illustrated by the following examples.

(1) A girl, aged 14 years, who had an I.Q. of 116, was referred because of lying and stealing. She saw in Card V " a vampire " and at the verbal inquiry she added: " It is flying." This is a very popular response, and her painting on a tracing showed on a superficial glance not much originality. On closer study, however, it showed a peculiarly restless design of the vampire's body which had obviously the purpose of evoking feelings of fear and horror. The vampire's face had somehow human features. When she was asked to concentrate on the vampire and to paint it just as it came into her mind, she produced a painting of an unusually-shaped window behind which a huge vampire was to be seen (Fig. 1). She said about this picture:

" It is the window of a castle. The vampire is after a person and flies all round but finds all the windows are closed. The window is a casement window with a sort of lattice work. I have seen such a window in my aunty's house; she is mummy's sister. Oh, mummy and aunty are always rowing; mummy acted as if she were two years old."

Paintings of Rorschach responses are often related to the subjects' dreams; indeed they are often painted dream-thoughts. When the girl described her painting of the castle and the vampire I was reminded of a dream which she used to have repeatedly when she was about 6 years old. This was the dream:

" I was in a cot and spiders were spinning webs all over the cot." Then the picture always changed and the second part of the dream continued in this way: " I was knitting as fast as I could, but could not keep up with mummy. I had the feeling of mummy's presence and she knitted faster than I did." These dreams were very frightening, and once her daddy woke her up. She was still half in the dream and said to him: " I have more knitting to do than mummy."

When she was asked whether she knew of a connecting link between the two parts of the dream she said: " I know—when spiders are spinning and closing in the webs get thicker and more matted and then give the appearance of knitting."

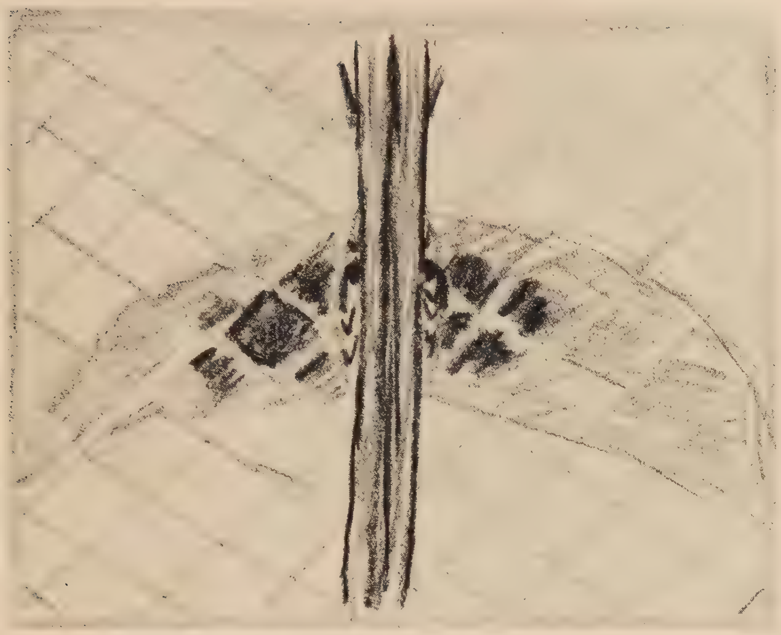

FIG. 1.—Card V—Active Imagination: "The casement window and the vampire."
♀, 14 years. I.Q. = 116.

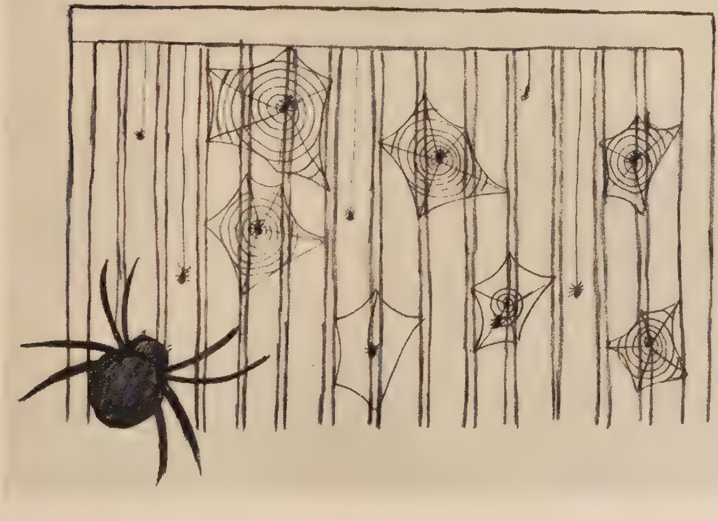

FIG. 2.—Drawing: "The dream of the cot and the spiders," ♀, 14 years.
I.Q. = 116.

The girl had made a drawing of her dream of the cot and the spiders before the performance of the Rorschach test (Fig. 2). When I showed her this drawing and asked her if she found any similarity between the two pictures she became very thoughtful. She was a self-willed girl and not likely to say something which she did not really feel. " Yes," she said, in a convincing tone.

" The lattice work of the window does look something like spiders' webs which they spin when they close in. Yes, it is a bit like my old dream, the window frame is a bit like a bar of a cot. There might be something similar with spiders and vampires. They both haunt people in different ways."

Spider and vampire were mother symbols. Both the dream of the cot and the picture of the castle had a continuation in which the mother appeared even in person. The dream of the cot changed into the knitting scene with mother, and the free associations when she described the castle, led her at first to her mother's sister's house, and then to a criticism of her mother herself. This revealed that at the bottom of the girl's trouble was a difficult relationship between her mother and herself. The analysis of the girl's Rorschach picture helped in gaining understanding of this relationship.

(2) The same girl gave to Card III, in the reversed position, to its upper central part, the following response : " Trees in a country lane, hawthorn hedges on the sides. Shadows cast by the trees in the lane. Here would be the sun."

The picture on the tracing showed that the response was conceived with great vividness, The sun was seen in the white space above the trees and their shadows gave a marked feeling of space and depth. The production of distinct vista responses in children always deserves special interest. For the child, like the primitive person, has little sense for the third dimension, and the appearance of vividly seen perspective in Rorschach responses is, in addition to other meanings which it may have, often a sign of growth of maturity. This girl, being the only child, was brought up in grown-up surroundings and was in many ways mature beyond her age. Her vista response seemed to be an expression of her growing maturity and innermost thoughts related to it.

She made another picture of the country lane from free imagination. It was colourful, gay and beautiful and showed many new details. There were orange-red hawthorn bushes, yellow honeysuckle and yellow corn, pink and red berries, wild mauve thistles, two oak trees and an alley of poplar trees. The orange-red sun and black shadows added considerably to the three dimensional impression. The picture was also alive with animals. Squirrels populated the trees, and rabbits ran across the lane. Also, inanimate movement was represented by falling leaves. To this picture she gave the following free associations :

" It was in Sussex. A short, quiet country lane. I stayed there for summer holidays. I liked that way. My parents were not there. Once I walked there after dark. It is a short cut. All woods. There were rabbit warrens nearby. Of course, you got hot walking. I put my coat off, it was adventurous."

When she was asked what her first impression was when she saw the inkblot she replied : " Immediately after I looked at the blot I thought of rabbits in the bush, because of the darker patches." Now, rabbits played a very great role in her life, as she was a keen rabbit keeper and most interested in the detailed study of their breeding and litters.

The image of the country lane appeared to have great importance for the inner life of the girl. The analysis revealed that it signified a longing for happiness, freedom and adventure away from the control of the parents, and especially her mother. The theme of the rabbits pointed to the growing sexual consciousness of the adolescent girl. There was also a spiritual note in the image. The lane was a " way," a " direction," leading into a distance towards an " aim." It was her way of life into the future, as she sometimes dreamt of it.

(3) Another girl came to the clinic because of pilfering. She was 10 years and 3 months old and had an I.Q. of 94+. Her mother was a person of bad reputation and deserted the home when the girl was 6 years old. The father remarried and the relationship between the stepmother and the girl was very good ; but the girl did neither forget nor forgive her mother.

On Card I she saw : "A lady. Her head is chopped off because she was careless on the road." On the tracing (Fig. 3) she painted the lady's body. Her frock was covered with blood. On the sides of it there was more blood, " because a car has run over her." On using active imagination she painted this scene with

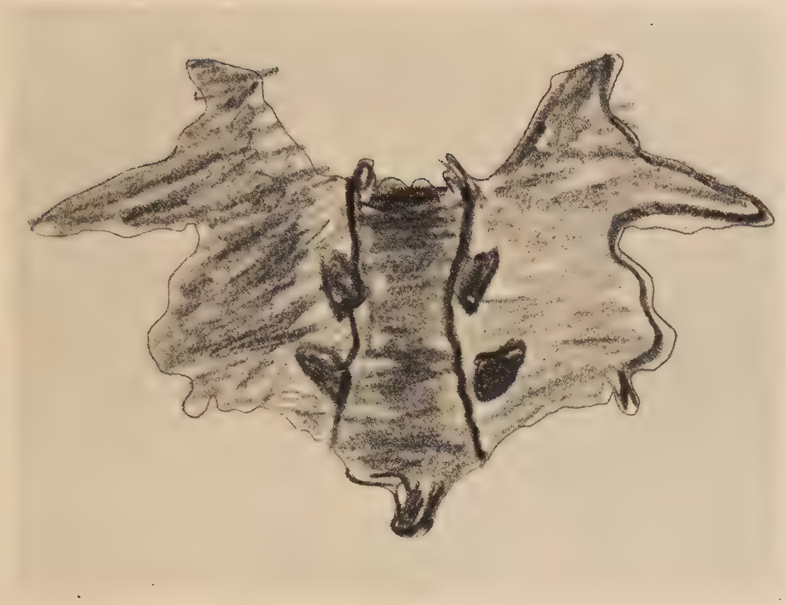

FIG. 3.—Card I—Tracing: "A lady with her head chopped off." ♀, 10 years 3 months. I.Q. = 94+.

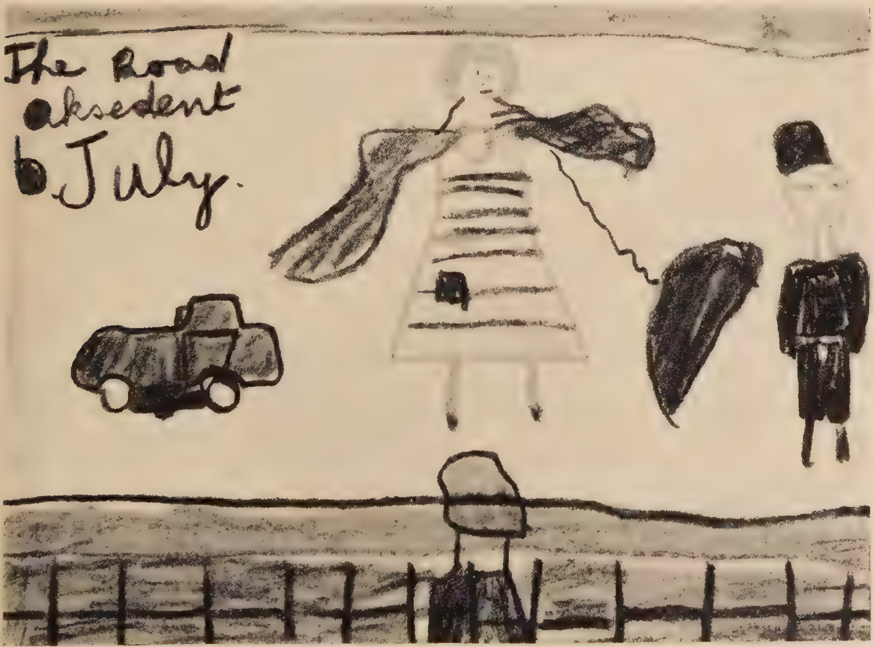
The Road
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FIG. 4.—Card I—Active imagination: "The road accident." ♀, 10 years 3 months. I.Q. = 94+.

great vividness (Fig. 4). The lady had a " nice yellow frock." Blood ran profusely from both sides of her neck and a pool of blood collected on the pavement. Her severed head was seen too. She had fair hair. The car was to be seen in the distance. Standing by was a policeman clothed all in black. He said that " it was all her own fault." A little girl, coming from school, saw the accident. She heard the creak of the car's brake and screamed and fainted. Then she fell into another lady's arms.

This phantasy described the catastrophe of the child's infancy as she experienced it : her beautiful mother, meeting with a mortal accident, because of her own fault, as the authority of the policeman stated, and her little girl seeing all and fainting and falling into the arms of another lady, her stepmother.

(4) A boy of 13 years and 5 months was on probation because of homosexual activities. He was an artistic, sad-faced boy with an I.Q. of 112. On looking at Card II, the lower part of the central white space appeared to him like " a ravine, by the dip as it falls, a rocky ravine, it could be in America."

He was asked to sketch the ravine as he saw it in his phantasy. He made a deep gulf on the edge of which were spiky cactus. " It is dangerous," he said. His attitude towards his offence was further shown when he made up the following story about the ravine : " One day I and my friend were working along the rocky ledges of the ravine. My friend slipped and fell to his death." When I asked him if there was not another, more cheerful end to the story, he decidedly shook his head. " No. This was the story."

(5) An almost mentally defective boy of over 14 years, who was troublesome at his boarding school, said about the small lower centre detail of Card VII : " This looks like a church." He drew the church with pencil on the tracing. It had a steeple. " Tell me all about it " he was asked, " and paint it now bigger and as you like it."

Immediately he set to work. " The church is in Lancashire, Sir, near my home, Sir, it stands on a hill, I was so happy there." He painted the church standing on a beautiful hill which was overgrown with wild daffodils A blue stream was flowing there. The sky was blue. The steeple had a round clock, which was like a sign of harmony. A boy was going to church.

The boy suffered from homesickness for his beloved home in Lancashire, which was the reason for his misdemeanour at the boarding school. This was movingly expressed by his painting. Since he made it he has happily returned to his home.

(6) A 13-year-old girl, who had an I.Q. of 127, made a painting from active imagination which was on a humorous note. Her problem was violent rages, and her obstinate wish to sleep in her parents' bed. Card IV looked for her like " a giant, a good giant, his name is Blunderbuss. He lives in a forest with his wife, Mrs. Blunderbuss is like Tom Thumb, because she is a dwarf." She painted the good giant who holds his tiny wife in his hands. This was a delightful unconscious allusion to the roles which in her mind her parents played in their relationship to each other and herself.

(7) A boy, aged 9 years and 11 months, with an I.Q. of 90, was very disobedient to his parents. His naughtiness developed after an attack of polio-encephalitis. He saw in Card I : " The devil springing from the wall." Whilst describing the devil he showed signs of fear of his own thoughts. His painting from imagination was outstanding because of the devil's big horns, of which he seemed to be particularly frightened.

After several months' treatment, when his condition was improving, this painting was again shown to him. The boy now told the following phantastic story ; it revealed in a touching way his inner struggle, the role of his mother, whom he identified with the Holy Ghost, and his eventual victory.

" One day a little boy was naughty and his mother said to him : ' Be good or the devil will spring out of the wall.' But the little boy did not take any notice. Just then he saw a horn poke out of the wall, and all of a sudden he saw a big face coming out of the wall with big eyes and two horns, and all of a sudden the Holy Ghost looked upon the one with the horns and said, ' What are you doing ? ' And the devil said : ' Mind your own business ! ' But the Holy Ghost said unto him : ' Why do you frighten little boys ? If you don't stop you will get into trouble.' But the devil took no notice and sprang up in a terrible rage. And the Holy Ghost. said to himself : ' I will tell him that I shall set him on fire.' And all of a sudden the devil said : ' I heard what you said, I have big ears.' "

"And just then the boy began to be good and his mother said: 'You may go out and play now.' And the boy could not help thinking that somebody's eyes were looking upon him. And he heard somebody speaking to him: 'Why do Thou be naughty?' And the boy took notice and said: 'I will be good.' And so he said to his mother: 'I am going to be good for ever.' And so he was."

And so the little patient was. After this decisive session his mother reported such an improvement that the treatment could be terminated.

THE STUDY OF MENTAL MECHANISMS.

The second value of the use of active imagination in paintings of Rorschach responses consists, as was said before, in the opportunity of studying mental mechanisms of artistic creativeness.

One can discern with the aid of these paintings how the original, actual percept of the blot is converted into an imaginary concept. One can also study the fascinating development of the primal concept into further and more elaborate concepts. Most interesting is the observation of a leading idea which links the original, actual percept with the most elaborate concepts.

The detailed description and illustration by examples of these mental mechanisms will be the subject of another study.

SUMMARY.

The Rorschach method is based on the stirrings of imagination.

This process is facilitated by the use of paintings of Rorschach responses.

The ability to create imaginative paintings is especially developed in children.

The imaginative material gained by paintings of Rorschach responses is particularly great when a technique is applied which uses the phenomenon of "active imagination."

The meaning of this phenomenon, which was described by Jung, is explained, according to various authors.

By the use of active imagination during the performance of the Rorschach test rich analytical material is often revealed.

This is illustrated by examples.

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DISORDERS OF TEMPORAL JUDGMENT ASSOCIATED WITH AMNESIC STATES.

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[Received 22 October, 1949.]

I. Introduction.

It is widely recognized that judgment of time may be grossly disturbed in amnesic states of organic origin. Korsakoff (1890), in his classic exposition of the syndrome which has come to bear his name, pointed out that memory for time is often more severely affected than memory for events, and that temporal reference may remain markedly defective, even after remission of the psychosis. Thus one of his patients was able to recall recent events with fair accuracy, but was unable to state whether a given event had occurred yesterday or three years before. After recovery, moreover, this patient presented disturbances in the temporal sphere as the most outspoken residual symptom. Korsakoff further observed that defects of temporal localization might appear as the most prominent manifestation in mild cases of the amnesic syndrome. It would seem, then, that disorders of time judgment form an integral part of this syndrome and may well reflect a disturbance of memory at its highest levels of psychological organization.

Temporal disturbances in amnesic states have been noted by a number of writers interested in memory disorders of the Korsakoff type. Bonhoeffer (1901) called attention to gross defects in retaining the temporal succession of events and to inability to appreciate the passage of time. Similar defects are also mentioned by Coriat (1904) in a discussion of reduplicative paramnesia and by Meggendorfer (1928) in his authoritative account of the alcoholic Korsakoff psychosis. It is to Van der Horst (1932), however, that we owe the first detailed analysis of temporal disorders in the amnesic syndrome. This writer pointed out that many of the errors of memory observed in such cases derive not so much from loss of retention as from improper temporal reference of recent events. Thus a patient who was given a cigar was able to recall this episode after a quarter of an hour, but incorrectly assigned it to the previous week. Again, the same patient stated that a doctor who withdrew from an interview for a few moments and then returned had been present at an interview on the previous day. Many further examples are given of cases in which recent events are correctly recalled but in which the patient is unable to estimate how long ago they took place. Order of sequence, in particular, is poorly retained. Thus the patient may correctly retain a number of instructions, but invariably carry them out in the wrong order. In the light of these observations, Van der Horst concludes that the amnesia bears especially on the temporal position and chronological sequence of recent events. On his view events themselves may still be remembered in the Korsakoff state, but their " temporal signs " are lost. He regards this inability to order consecutive events and the consequent loss of continuity in personal experience as the fundamental disorder in the amnesic syndrome. One may, however, point out that this interpretation, although viewed with favour by Gillespie (1937) in a well-known analysis of amnesia, has not won general acceptance (*cf.* e.g. Mayer-Gross and Guttmann, 1936).

Lidz (1942), in a more recent discussion of the amnesic syndrome, is also constrained to place emphasis on the defect of temporal synthesis. The amnesic patient, he points out, is incapable of linking events sequentially or with the general background of his experience. His impressions remain more or less isolated and can therefore be recalled with difficulty, if at all. Lidz calls attention, in particular, to defects in synthesis observed on tests of picture-arrangement and the like. Thus the patient, when given a series of pictures which form a connected sequence, fails to grasp the import of the series as a whole. Lidz does not, however, regard the loss of " time sense " as the basic defect, as does Van der Horst. He believes the fundamental disorder to be one of inaccessibility of memory material, i.e. a defect of recall. The patient is unable to regain material which has been followed by subsequent impressions : he cannot transpose himself in imagination into the recent past and set up the necessary orientation for adequate recall. The disorders in temporal reference and sequence are ascribed to this inability freely to evoke and utilize past experience.

A tendency on the part of amnesic patients to *antedate recent events* which they remain able to recall is evident from the examples given by Van der Horst (1932). A similar tendency was noted in a case of post-traumatic Korsakoff syndrome communicated by Paterson and Zangwill (1945). In this case not only was there gross over-estimation of the passage of time (e.g. one minute being estimated as a quarter of an hour), but also a notable tendency to refer quite recent events to a relatively remote past. Thus the patient would recognize his doctors from day to day, but would always allege that it was a matter of weeks or even months since he had last seen the particular member of the staff with whom he was now confronted. On one occasion a visit to a music-hall on the previous day was recounted with fair accuracy, but was said to have taken place at least a week before. There was evidence, too, that this tendency to over-estimate the interval which had elapsed since a given event increased with the further passage of time. Unfortunately, no systematic analysis of this effect was undertaken.*

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* We may note in passing that somewhat similar disorders in the temporal sphere have also been reported by Kleist (1934) in cases of brain injury, more especially in connection with lesions in the general region of the hypothalamus (*cf.* Delay, 1942, p. 98). It will be borne in mind that a number of cases of Korsakoff's syndrome have been described in which the lesion predominantly involves the basal parts of the diencephalon. It is possible, therefore, that both retention and appreciation of time are subserved, in part at least by neural mechanisms situated at a subcortical level. We shall not, however, consider further the problem of cerebral localization in the present paper.

The purpose of the present paper is to communicate some preliminary observations on temporal defects observed in amnesic states. First, an account will be given of errors of localization in time shown by three cases of chronic organic memory defect and by a small number of additional cases showing transient amnesic defects as a result of E.C.T. Second, some simple experiments on recall of order of sequence will be described. Third, some observations on the perception of sequence in both chronic and transient amnesic states will be briefly reported. It is hoped that our observations will be of help in defining with greater precision the role of temporal defects in the amnesic syndrome and thereby throw light on the organization of memory in general.

II. Experiments on Temporal Localization.

(1) *Chronic Amnesic Syndromes.*

Let us consider first some simple observations on time localization in three cases of relatively severe organic memory disturbance. The first was a case of outspoken Korsakoff syndrome; the second a case of disseminated sclerosis with profound changes in the mental sphere; and the third a case of presenile dementia. Co-operation on the tests was good in all cases.

Experiment 1.—The first patient, who exhibited a pronounced Korsakoff syndrome of some months' duration, was shown four simple designs at intervals of one minute and required to copy them in turn. Five minutes after the last design had been drawn, reproductions from memory were demanded. Only one design was reproduced with any semblance of accuracy. A recognition test was then given in which the four original designs were presented along with six new ones. The patient identified the original designs correctly, but *strenuously denied that they had been shown to her on this day*. She considered that they might have been shown her *several weeks previously*.

It will be seen that the patient, whilst recognizing the test designs correctly, grossly overestimated the length of time which had elapsed since their first exposure. An interval of five minutes is judged in retrospect to be a matter of several weeks.

Experiment 2.—The second patient, who gave evidence of a marked memory defect of organic type, was shown three successive designs each for a few seconds. He was then requested to draw them from memory. The first and third were correctly reproduced, but the second was not attempted. The patient recollected that there had been a second design, but was unable to recall what it was like. After a short distraction, in which certain other pictures were presented, the patient was entirely unable to recall having been shown the three designs. When shown them along with others, however, the original three were identified without difficulty, and the patient recalled having attempted to reproduce them. Asked when he was first shown them, however, he replied: " A long time ago; not this morning." When requested to be more precise, he specified: "*About a fortnight ago.*"

This observation is very similar to the first. An interval of a few minutes between presentation and representation of the test material is again treated as a matter of weeks.

Experiment 3.—The third patient, who displayed gross defects of recent memory, was shown three consecutive designs and required to draw them from memory. Only one of the reproductions was in the least like the original. After a brief interpolated task, in which three pictures were shown and described, the original designs were represented along with seven others. Six of this series, including the three originals, were treated as familiar. When asked when she had seen them last, the patient stated, " About a fortnight ago." and altogether denied that they might have been shown on the same morning. A further test of recognition was then given in which the three interpolated pictures were given along with a number of others, which the patient had not previously seen. Two were correctly and two incorrectly recognized. When asked how long ago the pictures had been shown, the patient replied : " I don't know how long ago it is since I last saw you ; perhaps some weeks, perhaps yesterday." She again denied that the pictures had been given on this day.

The above observations bring out clearly, in a test setting, the defects of temporal reference to which Van der Horst (1932) and Lidz (1942) have already drawn attention. Test material is identified, often with accuracy and confidence, but the patient has a very poor idea of when the original experience took place. In general, the errors in judging time-lapse were consistently *errors of overestimation.* Material which had in fact been shown only a few minutes earlier is said to have been given two or more weeks previously. It is probable that this tendency to antedate recent events is quite general in organic amnesic states.

(2) *Post-convulsive Confusional States.*

Some experiments analogous to those reported above were carried out on patients undergoing E.C.T. and may be briefly described. First, an attempt was made to study time reference in the later recall of material presented shortly before the administration of E.C.T. Second, an attempt was made to study time reference in the recall of material presented during the post-convulsive confusional state. It is hoped that the findings will supplement those obtained in chronic amnesic states.

Experiment 4.—The patient was an hysterical psychopath, aged 31. Design A was shown thirteen minutes and designs B and C one minute before the administration of E.C.T. Ten minutes later, after return to the ward, the patient was shown two further designs, D and E. On the following morning all five designs were re-presented along with others with which the patient was unfamiliar, and a recognition test given. The patient picked out Design A with confidence, B with less confidence and C " by guesswork." Designs D and E were not recognized at all. When asked when Designs A, B and C had been previously shown the patient's reply was quite correct in the case of A. Designs B and C, on the other hand, were referred to an occasion *during the previous week* when the patient had had an interview with the present examiner.

Experiment 5.—A similar test was given to a second patient undergoing E.C.T. In this case a Rorschach card was shown one minute before the shock was administered. When shown the card again on the following day, the patient commented : " Someone showed it to me yesterday ; *a long time before my treatment.*"

The above experiments show that, in some cases at least, material presented a minute or so before administration of E.C.T. is identified correctly, but its original perception is referred to a time appreciably more remote than is actually the case. As in the chronic states, there appears to be a tendency to antedate recent events in recalling them. In a few cases, however, errors in the estimation of time were found to be in the opposite direction, i.e. material shown before administration of E.C.T. was erroneously referred to the post-convulsive period. Two examples of this "post-dating" effect may be given:

Experiment 6.—A patient who was shown two pictures just before the current was applied was found to recall them correctly when interrogated 25 minutes after termination of the treatment. On the following morning, however, she alleged that the pictures had been shown her *after* treatment on the previous day. Three days later, E.C.T. was again given and on the day following the patient was found still to recall one of the pictures. She declared, however, that it had been shown to her on the *previous* day after her treatment. It would thus appear that the original perception was post-dated in recall by a period of some three days.

Experiment 7.—A patient shown two pictures just before administration of E.C.T. was found to recall them both quite clearly shortly after termination of treatment and on the following day. On the latter occasion, however, she alleged that the pictures had been shown her *after* treatment and not before. Three days later E.C.T. was again given, and on the day following the patient still remembered one of the pictures but alleged that it had been shown her just after treatment on the previous day. This indicates that the memory of the picture was post-dated by three days.

This post-dating effect will be discussed further at a later stage.

Striking defects in the temporal reference of material presented during the *post-convulsive confusional state* were also observed in some cases.

Experiment 8.—The patient mentioned in Experiment 7 was shown an unfamiliar picture 25 minutes after termination of E.C.T. Ten minutes later she recognized the picture correctly, but ascribed its first presentation to the *morning of the same day*; i.e. an hour or more before the time at which her E.C.T. was administered.

The above observation is typical of many which we have been able to record. Material perceived during the post-convulsive confusional state may, in some cases, be retained, but the original experience is apt to be placed at a considerably earlier time than was actually the case. As a rule, it is referred to a time an hour or more before the beginning of the treatment. No instances of a post-dating tendency were recorded.

(3) *Summary.*

(1) Marked defects in the time reference of recent memories are reported in cases of chronic amnesic syndrome and in the post-convulsive confusional state.

(2) These defects commonly take the form of gross overestimation of the time-interval which has elapsed since the original experience whose recognition or recall is demanded. In severely amnesic cases the tendency to antedate recent events may transform an interval of a few minutes into one of days or even weeks.

(3) In a small number of cases material exposed immediately before the administration of E.C.T. is post-dated on subsequent tests of recognition or recall.

III. EXPERIMENTS ON SERIAL ORDER.

We may now pass on to describe some experiments on the recall of the order of sequence of simple test items. These experiments were undertaken only with the chronic amnesic cases which included, in addition to those already mentioned, a deteriorated epileptic patient with gross impairment of retention and recent memory.

Experiment 9.—The above-mentioned patient was shown three simple designs in close succession and asked to reproduce them from memory. She drew the first two correctly but was unable to recall the third. Three pictures of common objects were then shown. Next, the patient was given a recognition test in which she was asked to select the original three designs from a set of ten. This she accomplished perfectly. At this stage, however, she entirely denied having been shown pictures of common objects. On a further recognition test, however, in which the three pictures were mixed with others, she identified correctly those which had been already shown to her and which she claimed earlier to have forgotten. Recognition, it is true, was greatly lacking in confidence. She now stated that she recalled having seen them but affirmed with some liveliness that they had been shown her *before the designs*.

The above observation shows that the order of sequence of the two sets of test material has been transposed. The pictures, in fact shown second, are said to have been shown first. It suggests, further, that items which can be spontaneously recalled or identified with conviction are ascribed to a more recent past than is the case with items which cannot be recalled spontaneously and which are identified only with hesitation.

Experiment 10.—This experiment was conducted with the patient who featured in Experiment 3 and who showed marked errors of over-estimation in recalling the times of recent events. On the present test the patient was shown three pictures of common objects, viz. (1) a pair of glasses, (2) a clock and (3) a fork. These items were correctly recalled after one minute. She was then shown three more pictures, viz. (4) a gun, (5) a chair and (6) a boot. On a test of recall of these latter items after one minute, the patient gave : " Gun, fork, chair and clock." She was then shown all six pictures, together with others, and asked to select those with which she was already familiar. The original six items were correctly chosen. Asked to specify the *order of sequence* in which they had been shown, however, she gave : (1) Boot, (2) glasses, (3) clock, (4) gun, (5) chair and (6) fork. It will be noted that the patient assigned the two items which she was *unable* to recall, viz. " boot " and " glasses " to the first two places in the series. It will also be noted that the patient, in her attempt at recollection, condensed two sets of three pictures into a single set of four.

The above observation suggests that, in recalling the serial order of unrelated items, those which are least well retained are assigned to the earliest places in the series. Items relatively well retained, on the other hand, are assigned to the later places, i.e. are treated as the more recent. It may be suggested that there is an important relation between adequacy of retention and the " time ordering " of recent events.

IV. Experiments on Numerical Sequence.

The last series of observations is concerned with the conditions under which consecutive events are perceived as building a related sequence. In the first place it might be suggested on general grounds that the order of sequence of items forming a conventional series is better retained than the order of sequence of disconnected items. This expectation appears to be borne out in the following observation.

Experiment 11.—The patient mentioned in Experiments 3 and 10 was first shown three simple designs and then some pictures of common objects. After a short distraction, it was found that she could not recollect any of the material, but identified all the items hesitatingly on a recognition test. She was quite unable to say whether the designs or the pictures had been shown first and, when asked to arrange all the items in order of sequence, did so with many mistakes. The experiment was then repeated in exactly the same way except that, in place of the three designs, the numbers 8, 9 and 10 were presented, each on separate cards. After an interval of some minutes, it was found that the patient could recall this series of numbers and in their correct order.

This observation shows that a simple numerical sequence can be retained despite failure to reproduce the serial order of disconnected items. In more severe amnesic states, on the other hand, even the capacity to form and retain the simplest numerical sequence may be grossly disturbed. This is well seen in the following examples :

Experiment 12.—The case of Korsakoff's syndrome mentioned in Experiment 1 was given four cards bearing the numbers 9, 10, 11 and 12 respectively. The cards were presented in serial order at intervals of one minute. The intervals were filled by copying designs. It was found that the patient entirely failed to relate the successive items as a numerical sequence and was able to recall only the third number at the end of the fourth minute. On a recognition test, further, this number alone was said to be familiar.

In the above case it would appear that the successive numbers are not perceived as forming a series and are rapidly forgotten.

A similar failure to appreciate sequence was noted also in certain patients when examined shortly after the termination of E.C.T.

Experiment 13.—A patient undergoing a course of E.C.T. was shown in the normal state a set of four cards bearing the numbers 5, 6, 7 and 8 respectively. The cards were given singly at intervals of 20 minutes. On the following day, all four digits were immediately reproduced on request. On another occasion, the same patient was given similar cards before and after administration of E.C.T. The numbers used in this case were 4, 5, 6 and 7. The first card was given 7 minutes and the second one minute before administration of E.C.T. The third and fourth cards were given respectively 23 and 62 minutes after its termination. On the following day the patient was given a set of cards bearing numbers from 1 to 15, presented in random sequence, and asked to choose those which had been shown on the previous day. Only the numbers 4 and 6 were chosen. When instructed to pick out others, the patient chose 3, 2 and 5. *No attempt was made to form them into a series.*

Experiment 14.—In a similar case to Experiment 13, cards bearing the numbers 7 and 8 were shown respectively, 15 and 1 minute before administration of E.C.T. and the numbers 9 and 10 respectively, 17 and 60 minutes after its termination. On a test of recall shortly after the last card had been given, the patient remembered only the first two numbers. On a recognition test next day, however, she chose 8 and 10 and believed both had been given after treatment. On being pressed to choose others, she hesitantly selected 7 and 9. The fact that *these four numbers formed a sequence appeared wholly to escape her.*

The above examples indicate that administration of E.C.T. may signally interfere with the capacity to grasp and retain a simple numerical sequence. In the second case it will be noted that the four numbers are correctly chosen on a recognition test, but that their serial order has been lost.

V. Discussion.

The most consistent finding brought to light by these various experiments is the tendency in recall to *antedate recent events*. This tendency has been noted in both chronic and transitory amnesic states and obviously calls for an explanation. The simplest explanation that might be advanced is to suppose that the " temporal sign " of a recent event depends on the intensity, vividness or clarity of its recollection. If this were the case, it might then be argued that a defect of retention, by reducing the clarity of a remembered event, causes it to be assigned to a past more remote than is in fact the case. An explanation of this kind, however, is almost certainly too simple. As many psychologists have pointed out, the clarity or vividness of a memory image is not a trustworthy guide to its age. Many experiences dating from early life may be recalled with great vividness and circumstantiality, but are not on that account referred to a more recent past. Indeed, it appears to be rather unusual for the vividness of a recollection to be used as a clue to its temporal location in past experience. We must conclude that time reference, in general, is to be ascribed to other and more complex psychological conditions.

It is probable that localization in time in normal remembering depends in large degree upon the retention of proper chronological relations between successive events which are accessible to recall. In memory for quite recent events, e.g. those of a single day, the normal individual has little difficulty in ordering his more outstanding experiences in proper sequence. Although these relations become rapidly disrupted with the passage of time, it is probable that they provide adequate time localization in short-term memory. In the recall of long-past events, on the other hand, it is probable that a broader chronological scheme is employed. The points of reference in such a scheme must be taken to be given by outstanding events in the course of personal life. Indeed, as Bartlett (1932) has suggested, the " dating " of a remote event may be a highly complex activity making use of inference and judgment in addition to recall in the narrower sense. It is an affair of construction rather than mere reproduction.

Now it is noteworthy that the defect in Korsakoff states almost certainly involves a breakdown in the chronological organization of recent experiences. One may hazard the view that an amnesic patient attempting to " date " an event which took place a few moments earlier is in much the same position as a normal individual attempting to " date " an event which took place some days or weeks previously. In both cases the original event is retained in memory, but lacks a firm anchor in the memory train. Portions of the latter continuous with the previous experience of what is now recognized or recalled are reinstated only with great difficulty. In anterograde amnesia, therefore, any recent event which is retained in memory has a certain quality of isolation. It is devoid of firm chronological links with neighbouring experiences which have preceded or followed it. It has an isolation comparable to that of a much more remote event recalled by a normal individual. This may well be the reason why it will appear to the patient as belonging to a more remote past than is in fact the case. It is also possible that, on tests of recognition, the patient interprets his lack of confidence as indicating that the material in question belongs to a more remote period. Although other factors may well be involved, an explanation along these lines is the most complete that can be offered in the present state of our knowledge.

It is still necessary to explain the *post-dating* effect described in certain cases of transient confusion following E.C.T. In these cases it is probable that the error arises from a condensation of two memories, viz. (*a*) the original presentation prior to E.C.T. ; and (*b*) the post-E.C.T. test of recall. On the following day the original material was correctly remembered, but the time-reference given is that of (*b*), the earlier test of recall. In this connection it is noteworthy that the post-dating effect was apt to become more marked with further lapse of time, suggesting that the original memory had undergone further condensation with more recent experiences. Analogous confusions in the dating of recent events are common in normal remembering.

The experiments on *serial order*, inadequate as they are, undoubtedly suggest that " time order " is, in part at least, a function of the ease with which the individual members of the series can be recognized or recalled. In general, items which are poorly retained are displaced to the earlier positions in the series and, in particular, an item which can be recognized but not recalled is assigned to an earlier position than one which can be both recognized and recalled with ease. These displacements in recall of serial order may perhaps be viewed as rationalizations of the memory failure. It is commonly supposed that forgetting depends solely on lapse of time and it would be easy for the patient to explain his inability to recall a given item by assuming that it had been presented less recently than one which he is able to remember. At all events, it must be borne in mind that order of sequence, even in normal subjects, is a factor extremely liable to disturbance. As Bartlett (1932) suggests, it may well be that the capacity to assign particular events to their correct sequential positions is a relatively late development in the evolution of mind. If this view is correct, recall of temporal relationships might be expected to prove particularly vulnerable to dissolution in organic mental disorders.

The experiments on the perception of *number sequences* do little more than confirm in a more systematic fashion the observations reported by Lidz (1942). Whether the disturbance of sequence-formation is to be regarded as primary or as secondary to the retention defect would appear very much a matter of opinion. We ourselves incline to the view that the disturbance is an effect of the memory impairment and not a primary want of synthesis in the sense of Van der Horst (1932). It is interesting, however, to compare this defect in temporal organization with the somewhat analogous defect in spatial synthesis which has been described as " simultaneous agnosia " in the German literature (*cf.* Lange, 1936). One might even speak of the disturbance noted in this paper as an " agnosia for succession,"

It is impossible in the present paper to enter into any discussion of temporal perception and its relation to memory in general. These problems have already been discussed in some detail by Janet (1928) and Schilder (1942). We must also refrain from attempting to bring our observations into relation with modern neurophysiological conceptions of the memory process, e.g. those developed by Ritchie Russell (1947, 1948). It is our hope that experimental studies of the type reported in this paper will have value in defining with greater precision the pattern of amnesic disability and thereby throw further light on the organization of memory in general. In these ways they may come to contribute towards the formulation of a comprehensive theory of memory and its physical basis in the central nervous sytem.

VI. Summary.

(1) A short review is given of disturbances in the temporal sphere which have been described in the amnesic syndrome.

(2) Experiments are reported on defects in the time localization of recent events observed in both chronic and transient amnesic states. It is pointed out that cases of amnesic syndrome commonly antedate recent events and that the resulting overestimation of time-interval is often gross. A similar though less extreme, tendency to antedate recent events is also described in the post-convulsive confusional state. In a few cases, on the other hand, errors are in the opposite direction and a post-dating effect is obtained. A tentative explanation of these errors in temporal judgment is attempted.

(3) Some further experiments are reported on the recall of serial order and the apprehension of numerical sequence. It is pointed out that order of sequence is exceptionally poorly retained in amnesic conditions and that those items which are best remembered tend to be regarded as the most recent. In severely amnesic states, disturbances in the apprehension of sequence itself may also be found.

(4) It is concluded that localization in time and the recall of serial order of recent events are aspects of memory particularly liable to dissolution in organic amnesic states.

We wish to express our gratitude to Dr. Joshua Carse, Medical Superintendent, Graylingwell Hospital, for his kind permission to refer in this paper to cases studied by one of us (M. W.) at his hospital.

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CAUSES OF NEUROTIC BREAKDOWN IN BRITISH SERVICE PERSONNEL STATIONED IN THE FAR EAST IN PEACETIME.

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[Received 12 November, 1949.]

Tredgold (1948) points out that the "importance of studying the mental health of British troops in the Far East . . . is unlikely to have diminished with the end of the war," and he emphasizes that "as long as conscription exists, the mental health of the young man doing his military service will be of great importance to the welfare of the community." For this latter reason the writer has thought it desirable to report some of the experience he gained during 1948. At that time, he was one of the two psychiatrists stationed in Singapore who dealt with the vast majority of the psychiatric casualties that occurred in the Far East.

The neurotic case-histories retained by the writer, and at present available, were not selected in any way, though their number is too small to be of statistical significance. However, impressions were formed during daily practice in the Far East and were based on points which were conspicuous by their recurrence, the cases quoted in this report being utilized merely to exemplify these various points.

Discussion of Factors Involved.

The etiological factors concerned in the motivation of the vast majority of the neuroses appeared to fall into three broad groupings, viz.:

(1) Cases with a frank neurotic history.
(2) Cases in which the "separation factor" predominated.
(3) Cases in which some factor which had been operative in the U.K. persisted whilst the patient was in the Far East.

One or more of these factors was present to a greater or a lesser degree. Their salient features may now be considered.

(1) *Frank Neurotic History.*

Only those cases in which the history points to obvious, undoubted neurotic features, or breakdown, are included under this heading. Case 16 is a typical example.

He was a Driver in the R. Sigs. Aged 19. Cat. A.1. Total Service, 1 7/12. Far Eastern Service, 6/12. He complained that "I always seem to worry." He was afraid he would have an accident whilst driving and asked to be taken off driving because of this. He gave a life-long history of nervousness. As far back as he could remember he had been afraid of the dark, heights, water, and crowds, *Table of Cases.*

Case No.	Diagnosis.	Rank.	Service and/or Arm.	Age.	Significance of etiological factors.		
					Frank neurotic history.	Separation factor.	Persistence of "U.K." factor.
1	Anxiety state	Driver	R.A.S.C.	19	0	1	0
2	Anxiety state	L./Cpl.	R.A.V.C.	20	1	0	0
3	Anxiety state	Pte.	R.A.O.C.	22	1	0	0
4	Anxiety state	Spr.	R.E.	22	0	1	0
5	Anxiety state	M.S.M.	R.A.S.C.	35	0	1	0
6	Anxiety state	L./Cpl.	R.A.O.C.	20	1	2	0
7	Anxiety state	W./Bdr.	R.A.	22	0	1	0
8	Anxiety state	Sig. II	R.A.F.	19	0	0	1
9	Anxiety state	Sgt.	R.A.F.	21	0	0	1
10	Anxiety state	L./Cpl.	R. Sigs.	19	1	0	0
11	Anxiety state	Yeo. Sigs.	R.N. (Shore base)	23	0	0	1
12	Anxiety state	Driver	R. Sigs.	19	2	0	1
13	Anxiety state	Spr.	R.E.	18	2	0	1
14	Anxiety state	L./Cpl.	R.A.S.C.	19	0	1	0
15	Anxiety state	L.A.C.	R.A.F.	21	0	0	1
16	Anxiety state	Driver	R. Sigs.	19	1	0	0
17	Anxiety state	Driver	R.A.S.C.	19	0	1	0
18	Anxiety state	Pte.	Infantry	21	0	1	0
19	Anxiety state	Pte.	Infantry	22	0	0	1
20	Anxiety state	Gnr.	R.A.	19	0	0	1
21	Anxiety state	S./Sgt.	R.E.	23	0	1	0
22	Anxiety state	L./Cpl.	R.A.O.C.	20	0	1	0
23	Hysteria	Pte.	Infantry	19	1	0	0
24	Hysteria	Pte.	Infantry	19	1	0	0
25	Hysteria	Pte.	R.A.O.C.	19	0	1	0
26	Hysteria	STO.	R.N.	22	1	2	0
27	Hysteria	Cpl.	R.A.S.C.	19	1	0	0
28	Hysteria	Pte.	R.A.O.C.	19	1	0	0
29	Hysteria	Sgt.	R.E.M.E.	20	0	0	1
30	Hysteria	Pte.	Infantry	20	0	1	0

Key to Table (adapted from McHarg).—1, Etiological factor considered to be of primary importance; 2, of secondary importance; 0, of no significance.

and had marked feelings of inferiority. These symptoms had materially interfered with his school life. He played truant very frequently, succeeded in avoiding most school games, and made no real school friends. He had complained to the school medical officer about his fears and inferiority feelings. They persisted into adult life. He worked on a farm after leaving school, and was able to plod along, though even there, following an incident with his employer, he developed a facial tick which was still present at interview. He had always been an anxious type, and his anxiety increased after entering the Army when he was thrown into intimate social contact with many of his fellow men. He managed, ultimately, to qualify as a driver, and was subsequently posted to the Far East, where he succeeded in carrying on his job for 6/12 before reporting sick.

This type of patient was frequently seen. He fell into that category of cases in which a fuller examination at a previous juncture would have been of significant value.

(2) *Separation Factor.*

In addition to symptoms due simply to separation from wife and/or family, this heading is intended to include the related domestic circumstances (e.g. illness of relative, infidelity of wife, bereavement) where separation was the prime factor in motivating neurotic breakdown. In this connection it should be noted that the cases under review consist chiefly of young National Service men who were called up a few years after leaving elementary school, or very shortly after leaving secondary or grammar school. Of the latter group, prior to entering the services, many young men had not yet come into contact with the world at large. Still in their 'teens, they were abruptly uprooted from a comparatively sheltered environment, and, within a short time, were posted over 8,000 miles from their homes to new and strange surroundings. In view of the peculiar circumstance of peacetime conscription, the age group under consideration (aged 18-20 approx.) contained numerous young men who were not yet able to stand on their own feet. They were still somewhat dependent and immature, and required a little longer for full super-ego development. They were, therefore, predisposed to " separation " symptoms, and it is not surprising that the separation factor was a potent cause of neurotic breakdown. Case 14 is illustrative.

He was a L./Cpl. in the R.A.S.C. Aged 19. Cat. A.1. Total Service 8/12. Far Eastern Service 2/12. He joined the army five months after leaving secondary school, and, as indicated above, he was posted to the Far East six months later. He came from a middle-class family of a small country town. He had lived at home throughout his school life, and family ties were very strong. There was no history of neurotic traits. He had known his fiancée for ten months prior to leaving the U.K., and had hoped to get married a few months later. On receiving the news of his overseas posting, the couple's marriage plans had to be changed. They decided it would be wiser to postpone the marriage till patient was released from the army. However, he never made a satisfactory adjustment to these arrangements. He developed intense supra-orbital and occipital headache (" like knives in my head ") and numerous somatic anxiety signs. He complained of incessant worry about his fiancée, the frustration of his plans, and frank homesickness. He added that his fiancée's family were not greatly in favour of the proposed marriage, and he feared that his absence from home might give them an added opportunity for interfering with his marriage hopes. Ultimately, his power of concentration diminished to such an extent that he was unable to carry on satisfactorily at his job, and he reported sick.

(3) *Persistence of " U.K. Factor."*

This grouping embraces those causative factors which were present whilst the patient was in the U.K., and persisted, in more or less the same form, whilst he was stationed in the Far East. In other words, the fact that the man was stationed in the latter theatre had little or no bearing on the factors precipitating his neurotic breakdown. Cases with a lifelong history of obvious neurotic tendencies are not included under this heading. Case 19 may be taken as an example.

He was a Private in the Infantry (Black Watch). Aged 22. Cat. A.1. Total Service 4 6/12. Far Eastern Service 1 year. He was a regular soldier and had another 2 6/12 to serve with the Colours. His history, prior to active service, was uneventful. He was married, had one child, and there was no domestic disharmony. He had been a Commando and had done parachute landings behind enemy lines in Europe. During one of his escapades, his left external ear was injured by a hand grenade, and a large part of the auricle was removed. There was no internal injury. He was subsequently taken prisoner in Germany. He stood up to these stresses very satisfactorily. After his release from the P.O.W. Camp, he returned to the U.K., and after a month or two he began to develop his anxiety symptoms, which persisted ever since, and were the presenting features of the clinical picture at interview. As noted above, he had been in the Far East for one year. He was timid and diffident. He appeared tense, careworn, irritable, and anxious. He complained, "They make fun of me because I've only half an ear. They say, 'Shut up, or I'll cut your other ear off,' and cracks like that. . . . I don't want the same thing to happen again and again." He felt that people in the street were staring at him. However, there was no evidence of more frank psychotic thinking. He was responsive, intellectually intact, and in good contact.

In this case, the appearance of his left ear was the direct cause of self-consciousness, mild ideas of reference, and anxiety symptoms. The injury had occurred in Europe. Anxiety symptoms developed in the U.K., and remained active whilst the patient was in the Far East. The latter, however, played no obvious part in their motivation.

Though the factors noted above were the positive agents precipitating neurotic breakdown, some additional general points of a negative kind contributed towards the total etiological picture. They will now be considered.

(i) *Absence of enemy action.*—One of the characteristic features of the period under discussion is the virtual absence of large scale enemy action. Not a single psychiatric casualty was seen by the writer as a result of the bandit activity up-country in Malaya. Though the presence of enemy activity, therefore, has been much discussed as a cause of neurotic breakdown, it must not be forgotten that, in certain specific circumstances, its very absence may be a causative factor. Not only for the front-line soldiers, but for the vast armies behind them, the activity of the enemy creates a rallying point which helps to canalize the troops' latent energies. When it is remembered that the personnel being considered were mainly young conscripts with no fundamental interest in service life as a career; that they were stationed overseas, thousands of miles from home, in a strange country; and that they had not even an "enemy" to talk about—it will be realized that fertile soil existed for the growth of neurotic symptoms.

(ii) *Absence of aims.*—The lack of enemy activity leads logically to the still more general problem of the lack of obvious aims and objectives, as far as great numbers of servicemen were concerned. Though the absence of adequate aims may have been a serious difficulty in wartime, especially in connection with servicemen stationed in base areas, it is a problem of much greater moment, psychologically, in peacetime. When a war is in progress, even the soldier stationed in the most isolated outpost can attempt to see himself as a small link, however insignificant, in the chain of fighting services arrayed against the enemy. He can visualize himself contributing something towards the total force which is attacking the enemy power. Moreover, this contribution can be crystallized into an aim, the object of which is to defeat the enemy, thereby safeguarding one's country, wife and family, or political outlook. Such goals are real and conceivable.

In peacetime, the situation is different. The *raison d'être* for the very existence of the armed services, especially to a young conscript, is frequently a somewhat nebulous affair. It is difficult to see any obvious danger, and nothing very material appears to be at stake. Diplomatic expediency and political ideas seem rather remote justifications for a posting to Malaya. In other words, the objectives of service life can no longer assume a concrete form, but have to be appreciated on an abstract and conceptual plane.

(iii) *Absence of "limelight."*—With the return of peace, public opinion naturally shifted the emphasis from service life to civilian problems. However much conscription was heralded as a national necessity, many servicemen genuinely felt that they could be more usefully and economically employed on the civilian front. In the Far East they felt they were in a "backwater." They received letters from home telling how friends were settling down and progressing with their careers, and the wartime feeling that, for better or worse, "we're all in it," no longer seemed to hold. Service life appeared to resolve itself very largely into a purely negative existence—one of absence from the things that really mattered—with few redeeming features.

For the conscript, this attitude was further prejudiced by the fact that, even with the services, he was not always welcomed by his "regular" colleague. In wartime there was an evident necessity for mobilizing the nation for the armed forces. In peacetime the regular was not so ready to accept a similar situation. He had anticipated a revival of pre-war service life, with training schemes and so on, planned on a long-term basis, and he felt that the presence of the conscript and his (presumed) lack of fundamental interest in the services was interfering with these ambitions and lowering the morale of service life generally.

General Discussion.

Cameron (1949), discussing the effect of a tropical climate on naval personnel, says that many of the reactions are relatively quickly accepted, and that the most important phenomenon is "tropical loss of memory," probably metabolically determined. He considers that somatic and emotional tension results from an effort to overcome this intellectual impairment "if the need for continuous concentrated intellectual work is imposed on one." The latter, however, was not a prominent feature of the average man's service for the period under review by the present writer. Persistent intellectual effort was not conspicuous in any of the cases tabulated. The great mass of servicemen in the Far East were engaged in very routine duties, and the complaint was usually not one of excessive concentration, but of lack of activity and frank boredom.

The factor of separation from home has been frequently discussed (e.g. Main, 1943; Grieber, 1945; Burdon, 1944; Tooth, 1944; Tredgold, 1948). In spite of the fact that the majority of the servicemen under consideration were conscripts with a definite and limited period for duty in an overseas station—approximately two years, at the maximum—separation anxiety loomed prominently in neurotic breakdown. The importance in this connection of the comparatively young age group of the bulk of the personnel has already been discussed.

Tredgold, Heffernan, Kelly and Leigh (1946), studying officer psychiatric casualties in the Far East in wartime, considered that the absence of adequate outlet for aggression, and the feeling of not being actively engaged in the war, were important precipitating factors. The latter feeling was also emphasized by Grieber (1945) in connection with the non-combatant psychiatric casualty overseas. Though these writers are concerned with the lack of operational activities and adequate stimulating factors in wartime, a comparable lack is even more obvious in the peacetime period at present under review.

Rees (1943) noted that boredom was an important cause of neurosis in the army. This factor remains conspicuous, if not of greater psychopathological significance, in personnel stationed overseas in the post-war era.

Grieber (1945) points out that "unstable personalities whose histories reveal neurotic reactions, both in civilian life and prior to coming overseas," tend to become casualties whilst overseas, even though they are not engaged in combatant duties, and Logan (1941), discussing psychiatric illness in Singapore, notes that "in the majority of cases there existed a strong indication for caution in permitting overseas service." It is hardly surprising, however, that men with frank neurotic histories should continue to have their neurotic symptoms whilst stationed in the Far East. Many of the cases seen by the writer fell into this category, but this does not, of itself, implicate the Far Eastern milieu in the pathogenesis of the neurotic breakdowns.

Peacetime conscription is an innovation for this country, and the period covered by the present report is therefore of peculiar significance. Wartime hazards and wartime stimulants are largely absent. Though the Far East may be hot and humid, the average serviceman has a placid and routine existence. It is felt, therefore, that for the period under review, local factors in the Far East played an effectively unimportant part in the motivation of neurotic breakdowns. The potent causative agents, such as frank neurotic tendencies, separation, persistence of "U.K." factor, absence of aims, enemy action, and "limelight," bear no specific relationship to the Far East as such, being applicable to personnel stationed in any overseas theatre.

As far as preventive measures are concerned, most of these follow logically from the nature of the problems under discussion. Lack of aims and objectives, for example, has to be tackled by measures directed towards encouraging a better understanding of the purpose and functions of the peacetime services and relating these to the responsibilities of the individual and the part he plays as a functionary of a particular service. The majority of these preventive procedures have been considered by other writers (e.g. Beaton, 1918), and it is not intended to review them here, but two of the possible lines of approach require emphasis in connection with the present discussion.

Firstly, men with gross neurotic histories still get posted to the Far East, and it would seem that the initial selection procedures remain at fault in this respect. Sims (1946) says ". . . with the best selection there would be no psychiatric casualties, but this is really a theoretical 'best' for it would be impossible to gauge the breaking point of many, and while they might not become mentally ill through action, domestic trouble may precipitate the breakdown." Though the absence of "action" in the causation of neurotic breakdown is relevant to the present report, it is felt, nevertheless, that much greater care and discretion is still required in connection with overseas postings. As Logan (1941) wrote, ". . . psychical casualties overseas could be easily and greatly reduced by an efficient weeding out of such susceptible individuals at recruiting time or prior to transfer abroad."

The second prophylactic measure that requires stressing concerns compassionate repatriation. Tredgold (1948) refers to the numerous difficulties attending its implementation. Moreover, in deciding whether or not to grant compassionate repatriation, only the gravity and severity of the domestic situation itself is weighed by the authorities. The likely effect of that situation on the man serving overseas is not necessarily considered to be strictly relevant to the problem. It frequently happens, however, that a given domestic difficulty may not fall into the category of an acute emergency, but in spite of this, if the stress continues and if the man remains overseas, the domestic factor may—in a measurable length of time—precipitate psychiatric breakdown. If such a man is seen at a comparatively early date, it may appear prudent, from the point of view of prophylaxis, for the psychiatrist to advise compassionate repatriation. It is unlikely, however, for the reasons already stated, that this advice will be acted upon. Technically, the only alternative for the psychiatrist is to wait until the man's condition deteriorates to such an extent that a frank psychiatric abnormality develops, the severity of which justifies returning the patient to the U.K. The writer feels, therefore, that in the type of case under discussion, some alternative procedure should be available whereby, as a consequence of psychiatric evaluation and advice, it would be possible (i.e. the machinery would exist) for compassionate repatriation to take place as a preventive measure before a florid clinical syndrome presented itself.

Summary and Conclusions.

Neurotic breakdown in British service personnel stationed in the Far East in the post-war "conscription" era is considered from the standpoint of etiology.

Thirty cases are tabulated. They are used solely to illustrate specific points, the number being too small for statistical evaluation.

It is noted that, due to the innovation of peacetime conscription, the period under review is of peculiar significance, and it is suggested that, for this period, local factors in the Far East played an effectively unimportant part in the causation of neurotic breakdown. The potent factors, etiologically, are considered to include frank neurotic tendencies, the separation factor, and those factors which were present in the U.K. and remained operative whilst the man was stationed in the Far East. Important secondary factors, of a more general and negative kind, contributed towards the total etiological picture. They include the absence of enemy action, the lack of aims and objectives of numerous servicemen, and the absence of "limelight" for service personnel, due to the shift in the emphasis of public opinion from service life to civilian problems.

The possible preventive measures are not reviewed systematically, but two procedures are considered to require special stressing in view of their relevance to the type of case under discussion. The first concerns the need that still exists for greater care in connection with initial selection procedures and overseas postings. The second centres on the need for machinery whereby, as a consequence of psychiatric advice, compassionate repatriation could take effect as a preventive measure, even though the domestic situation

might not fall into the official category of an acute emergency. The reasons for making these suggestions are stated.

I wish to thank the Director-General, Army Medical Services, for permission to publish this paper.

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TRICHLORETHYLENE NARCOSIS AS A THERAPEUTIC AID IN PSYCHIATRY.

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[Received 6 January, 1950.]

The influence of narcotics, such as alcohol, in promoting loquacity and even veracity has been known from ancient times, as implied in the old proverb, "In vino veritas." The deliberate use of narcotics for the study of the psychopathology of psychiatric disorders is, however, a comparatively recent development.

During the First World War Starkey (1917) used light ether narcosis to help in the treatment of war neuroses. This use of volatile anaesthetics as adjuncts to psychiatric therapy was not however developed or elaborated to any extent and, in fact, was superseded by the introduction of intravenous barbiturates by Bleckwen (1930). Bleckwen used sodium amytal to facilitate the induction of hypnosis and also in criminological work to elicit information from difficult witnesses. The term narcoanalysis was introduced by Horsley, in 1936, to denote the technique of facilitating psychotherapy by the intravenous administration of such barbiturates as pentothal and nembutal. During the Second World War, when the time factor in treatment became a matter of urgency, intravenous barbiturates rapidly gained popularity in the treatment of war neuroses (Sargant and Slater, 1940; Mallinson, 1940; Wilde, 1942; Grinker and Spiegel, 1943; Lambert and Rees, 1944). Concurrently, a revival of interest in the psychotherapeutic uses of volatile anaesthetics took place.

Rogerson (1944) introduced nitrous oxide for narcoanalytic purposes. The use of ether, particularly for abreactive techniques, was elaborated by Sargant and Shorvon (1947), and chloroform was used in a large series of cases by Edkins (1948). Trichlorethylene (trilene) was used at Mill Hill Emergency Hospital in 1944 by one of us (L.R.) for the treatment of service patients suffering from neurosis, and subsequently by the authors at the Neurosis Centre, Whitchurch Hospital, Cardiff.

PRACTICAL ADVANTAGES OF TRICHLORETHYLENE.

Trichlorethylene was found to have practical advantages over other methods of inducing states of narcosis suitable for psychotherapy. It has the very important advantage of safety and ease of administration. In addition it has the following advantages :

Compared with Chloroform and Ether.

1. It is non-irritant to the respiratory passages.
2. Its faint smell is not usually regarded as unpleasant.
3. Induction of narcosis is easy.
4. Nausea and vomiting do not occur.
5. Toxic action on the liver is less.
6. In contrast to ether, it is non-inflammable and non-explosive.

Compared with Nitrous Oxide.

Nitrous oxide has a disadvantage in that the narcotic state produced with the technique described by Rogerson (1944) utilizing Minnett's apparatus is usually too transient for prolonged psychotherapy.

Compared with Intravenous Barbiturates.

1. The method does not require any complicated preparations, e.g. preparing syringes, tray and other requisites for intravenous injection.

2. Patient may hold the mask and administer it himself, thus tending to overcome any tendency towards anxiety about the procedure.

3. The optimum degree of narcosis can be determined automatically during self-administration by the release of pressure of the hand on the mask.

4. The main effects pass off in a few minutes and patients are able to resume normal activity after a short time in contrast to barbiturate narcosis where the effects may prevent this for as much as 2 to 3 hours. The method is also free from such effects as headaches, ataxia, etc., that may occur with intravenous barbiturates.

PROPERTIES OF TRICHLORETHYLENE.

Trichlorethylene (or Trilene) is a colourless sweet-smelling liquid, having the formula $CHCl:CCl_2$. It was discovered in 1864 and is widely used commercially as a solvent for fat and grease. It was used for general anaesthesia by Jackson (1934), but its widespread use is mainly due to its reintroduction by Hewer (1941) and it is now used extensively for general anaesthesia in surgery, and analgesia in midwifery. It is also used by inhalation to relieve the pain of trigeminal neuralgia (Plessner, 1915 ; Glaser, 1931), angina pectoris (Love, 1937) and migraine (Rubenstein, 1937 ; Geiger and Goodman, 1937). It is interesting to note that the relief of pain in these conditions is considered to be due to its central depressant effect (Goodman and Gilmour, 1940). Trilene acts as a central nervous system depressant, just as chloroform and ether, acting first of all on the cerebral cortex, in accordance with the general law that the most recent phylogenetically developed parts of the nervous system are the first to be affected.

METHOD OF ADMINISTRATION.

The degree to which trichlorethylene produces its effects will depend, as with other volatile anaesthetics, on the partial pressure of the vapour and the respiratory minute volume. Various methods are now available for administering it. We have found Simpson's Inhaler and Elam's apparatus simple and effective. The most suitable apparatus in our opinion, however, is the Oxford Vaporizer, as this allows the concentration of trilene to be controlled and has addition practical advantages to be described.

TECHNIQUE.

The decision to employ trichlorethylene narcosis is only made after obtaining the history and carrying out examination of physical and mental state, and such other investigations as may be necessary. The action and purpose of the treatment is explained to the patient in suitable terms in order to enlist his full co-operation. As the degree of narcosis is light, no special premedicative measures are necessary. While no tendency to vomiting has been noted, it is considered undesirable that trilene should be given after a heavy meal. The patient is placed comfortably on a chair or couch. His collar is loosened and any dentures removed. He is encouraged to relax and to breath fairly deeply through the mask. If he is apprehensive it may help to allow him to hold the mask himself. With Simpson's Inhaler and Elam's apparatus the optimum degree of narcosis is usually induced by 15 to 30 breaths, varying with the individual depth of breathing and concentration of trilene. With the Oxford Vaporizer the concentration of trilene is gradually increased by moving the regulating arm at stages from 0 to 15 as necessary. The optimum phase of narcosis is reached more quickly than with Simpson's Inhaler and Elam's apparatus; it is indicated by relaxation of the patient's grip on the mask. If the physician holds the mask, he can detect the required degree of narcosis by noting the onset of relaxation and steady breathing and in particular by observing the patient's response to questions. In the optimum phase the patient becomes more communicative, talks more readily, may become emotional and may laugh and weep. After a little experience the physician is able to detect the optimum phase without difficulty.

With the Oxford Vaporizer a very valuable additional technique is possible. This consists in holding the mask a few inches from the patient's face and maintaining a steady flow of gas by depression and elevation of the rubber bellows so that the patient continues to inhale a gaseous mixture and is able to speak unimpeded by the mask. When this technique is employed it is necessary to increase the concentration of gas by moving the regulating arm because of dilution of the mixture with air.

THERAPEUTIC USES.

The state of narcosis produced by trilene may be utilized in the following ways:

1. To facilitate analytic procedures.
2. To uncover amnesia.

3. To promote abreaction.
4. To help relaxation.
5. To aid the production of hypnosis.
6. To facilitate treatment by suggestion.
7. To reinforce reassurance.

NARCOANALYSIS AND THE TREATMENT OF AMNESIA.

During trichlorethylene narcosis patients usually feel calm and relaxed, with increased feelings of warmth and friendship and an increased desire to talk. They feel able to discuss personal matters more easily, especially if they were previously willing to talk, but were impeded by shyness and embarrassment. The patient is allowed to talk freely and if necessary prompted by clues gained from the history. In dealing with periods of amnesia the patient is asked to describe the events leading up to the period for which memory is lost, and then encouraged to recall and describe the events of the amnesic period. Trilene narcosis is one of the simplest methods of recovering memory in hysterical amnesia and is found to be equally as effective as intravenous barbiturates for the purpose.

ABREACTION.

The following technique is employed to produce abreaction during trilene narcosis. With the patient in the light narcotic state, he is encouraged to relax and is told that he will be able to recall past events readily and vividly. The physician, from his knowledge of the case, asks the patient to recall a particular situation as if he were actually there. If possible, a situation just prior to the one believed to have been the traumatic experience is chosen, and the abreaction is then worked up from this. The recall is made more realistic and intense by repeating back to the patient, in the present tense, the events described, as if the experience was actually in progress. Full expression and liberation of emotion is encouraged and the patient is reassured as necessary that, in spite of his fears, he is safe. Each fear-arousing situation is repeated and, if necessary, is reinforced by the physician until the re-enactment and abreaction reaches a climax in which the patient may scream, weep, writhe, tremble, burrow himself into the bed or throw himself about. The abreaction should be as complete as possible during the session, which should always be terminated by appropriate explanation and reassurance.

RELAXATION.

During trilene narcosis muscular relaxation can be fairly readily induced by persuasion. Successive muscle groups are relaxed, starting from the feet, then the legs, head and neck, until the whole body is in a state of deep relaxation. Relaxation procedures such as this were found to be useful in the treatment of recent stammers, hysterical aphonia, hysterical tremors and spastic gaits and also as a prelude to hypnosis and abreaction.

Hypnosis and Suggestion Therapy.

The narcotic state produced by trilene can be changed into a true hypnotic state by suitable suggestion, the physician employing any special technique or device of his choice in the process. The facility with which a true state of hypnosis can be achieved varies with the patient. It has been noted that the suggestibility of many patients appears to be increased during trilene narcosis, whereas in others no increase of suggestibility is evident.

Removal of hysterical symptoms by suggestion is in many cases made easier with the help of trilene narcosis. Hysterical symptoms usually require firm persuasion and suggestion applied with determination. Restoration of function should, if possible, be achieved in one session. The patient should be made to continue using the recovered function into the full waking state.

It should be emphasized that the removal of the hysterical symptom is, of course, only a comparatively small part of the treatment of hysteria. The more important part of the treatment is the elucidation of the psychopathology and the solution of the patient's underlying problems. Whereas, ideally, this should be completed before removal of the symptom, it is also important to achieve early functional reintegration in order to prevent habituation and incorporation of the symptom into the patient's personality and behaviour pattern.

Reassurance.

The alleviation or disappearance of symptoms during trilene narcosis can be used therapeutically by .proving to the patient that his symptoms are not immutable and are, in fact, reversible. This application is valuable in hysterical conversion symptoms, somatic manifestations of anxiety and somatic symptoms resulting from emotional tension.

Diagnostic Uses.

Trichlorethylene narcosis may be used diagnostically by eliciting further information in cases in which the psychopathology is not clear. It may sometimes help in the differential diagnosis of irreversible organic changes and functional disturbances, e.g. pains due to muscular tension resulting from emotional disturbance, by removal of hysterical tremors and spastic paresis and by the removal of such conditions as hysterical choreiform movements and hysterical pseudo-Parkinsonism.

Discussion.

Trichlorethylene narcosis should be regarded as a therapeutic adjunct and not by any means a method of treatment in itself. The use of any procedure such as this must be based on as complete a knowledge of the patient as possible, including the dynamic factors contributing to the development of his illness. The value derived from its use will largely depend on the skill and enthusiasm of the physician. In these respects it does not differ from the psychotherapeutic uses of intravenous barbiturates and of other volatile anaesthetics. It is also entirely true to say that the therapeutic results obtained by such techniques could be achieved if sufficient time were devoted to treatment without their use. The main advantages accruing from the use of narcotic states for psychotherapeutic purposes are in saving of time and effort.

Trilene narcosis, induced by the technique described, is probably one of the simplest, safest and most convenient methods of producing a state of narcosis suitable for psychotherapy. The method allows early resumption of activity, and is suitable for treatment in out-patients clinics and in the wards of general hospitals. If necessary, it may be repeated a number of times the same day. It has already been noted that the degree to which suggestibility is affected during trilene narcosis shows considerable individual variation. In this connection it is interesting to note that Eysenck and Rees (1945) demonstrated experimentally that increased suggestibility during states of narcosis produced by sodium amytal and nitrous oxide occurred mainly in patients with a high degree of primary suggestibility. Patients who were not suggestible on tests of primary suggestibility, such as body-sway tests, were not made more suggestible during narcosis. This finding explains the varying effects on suggestibility produced by intravenous barbiturates and volatile anaesthetics, and may explain failure to produce hypnosis or succeed with therapeutic suggestion in some patients even when aided by narcosis. The help given by narcotics and anaesthetics in producing a state of deep hypnosis may, to a large extent, depend on giving the physician greater confidence in achieving success.

The most suitable patients for narcoanalytic treatment and abreaction with trilene were those in whom there had been recent situational conflicts or traumatic experiences. The technique was found particularly valuable in the treatment of war neuroses. The method was not so valuable in the treatment of disorders arising out of life-long personality problems, and was not found to be helpful in the study or treatment of long-standing psychosomatic disorders, e.g. gastro-duodenal ulcer patients in whom constitutional factors rather than extrinsic causes seemed to be dominant in the aetiology.

We may conclude by saying that the psychotherapeutic use of trichlorethylene narcosis is eclectic, allowing the physician to use any approach he may prefer, and that it serves as a focal point in treatment in which maximal therapeutic endeavour may be concentrated. The technique must be regarded as a tactical aid in treatment and the results obtained will largely depend on the operator.

SUMMARY.

1. The development of the use of narcotic and anaesthetic agents in psychiatric treatment is briefly reviewed. The properties of trichlorethylene are described and the advantages of trilene over chloroform and ether, nitrous oxide and intravenous barbiturates are discussed.

2. Various methods of administering trilene are described and the best method is considered to be the use of the Oxford Vaporizer, which allows of a special technique enabling the patient to continue inhaling the gas unimpeded by a mask.

3. The method is eclectic and the therapeutic uses of trilene narcosis include narcoanalysis and narcosynthesis, removal of amnesia, facilitation of hypnosis and treatment by suggestion, abreaction, facilitation of relaxation procedures and reinforcement of reassurance.

4. Diagnostic uses include elicitation of further information when the psychopathology is not clear, and in the differential diagnosis of irreversible organic lesions and of conditions produced by increased emotional tension.

5. The appropriate place of narcotherapeutic techniques in psychiatric treatment is discussed, and it is emphasized that such methods must be regarded as tactical aids and that the results obtained will largely depend on the operator.

Acknowledgment.

We wish to thank Dr. William Mushin, Director of the Department of Anaesthetics, Welsh National School of Medicine, for valuable advice on the Oxford Vaporizer, and Dr. T. J. Hennelly, Medical Superintendent, Whitchurch Hospital, Cardiff.

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STUDIES ON PSYCHIATRIC PATIENTS UNDERGOING NITROUS OXIDE TREATMENTS.

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[Received 18 October, 1949.)

Two major stages can be distinguished in the historical development of dynamic psychotherapy. In the first stage, ushered in by the early Freud and his disciples, the therapist was concerned mainly with the intellectual understanding of the aetiology of the patient's maladjustment. In the last ten years the emphasis has shifted and at the present stage psychotherapeutic theory and technique have advanced from purely analytical search for traumatic incidents to the task of grappling more directly with the patient's emotional disturbances. The major importance of the therapeutic doctor-patient relationship, of abreaction and working-through of the patient's conflicts has been recognized. These two historical attitudes reflect, of course, the progression of psychotherapy in each individual case, from gathering material to the understanding of its emotional charges. We still have little knowledge, however, of the last act in the puzzling drama of the patient's recovery, namely, the actual achievement of insight on the part of the patient. We all know that there are patients who fail to get well although the therapist and the patient have a clear understanding of the dynamic structure of the disturbance, have experienced, discussed, and understood again and again the emotional manifestations occurring in the doctor-patient relationship. Somehow these patients are not able to transform intellectual insight into emotional insight.

In their work with nitrous oxide therapy (1) the authors gained the impression that this technique may be of value in helping the patient to take this last important step towards reality adjustment. This paper is an attempt to analyse on a phenomenological basis the effects of brief periods of loss of consciousness induced by the inhalation of nitrous oxide.

Different individuals have different modes of abandoning consciousness and their contact with reality. Most people show little or no excitement during nitrous oxide narcosis. Some do not move at all from the moment the mask is placed over their face until it is taken off again two or three minutes later. Others move their head as though trying to shake off the mask. Many move their arms or legs following patterns which have been described in publications dealing with nitrous oxide anaesthesia and seem to be very similar to the motor patterns during inhalation of carbon dioxide as described by Meduna (2). There are persons who perform certain movements, such as snapping the fingers, clapping the hands, kicking the legs, at certain periodical intervals in order to set "landmarks" of consciousness which enable them to demonstrate that they are still capable of controlled and spontaneous movements. These are people who want to be conscious even of their loss of consciousness. There is a group of patients, usually alcoholics, paranoids, or latent homosexuals, who become extremely excited and combative after about a minute of inhalation when they are at the point of losing consciousness completely. Finally, there are the patients, mostly excited manic or catatonic, who are struggling even before the treatment is started and who have to be manually restrained in order to administer it.

Just as there are different modes of reaction to the loss of consciousness, there are also different ways in which the person re-establishes his conscious state and his contact with his environment. Some subjects become conscious almost at once after they have taken two or three breaths of air or oxygen. They may immediately rise to a sitting position on the table and laugh or talk excitedly. Others will remain lying quietly and will not initiate any action for one or two minutes after nitrous oxide has been discontinued. During this time they seem to be engrossed in reverie or even actually dreaming, sometimes with their eyes open. They respond, however, immediately when spoken to. A third, comparatively small group remains confused or in a fugue-like state for several minutes. During this state no real contact can be established with them although they may get up and move about the room talking, shouting or singing.

The patient with anxiety will often wake up with sudden alarm. The hysterical patient frequently shows automatic behaviour upon awakening. The schizophrenic patient who is not in an acute phase of the disease often remains self-absorbed and preoccupied following the termination of the anoxia. Manic and depressed patients often show a reversal of their dominant mood on awakening. The healthy, not disturbed individual re-establishes his contact with reality as a rule in a fairly rapid though quiet manner. There are different facial expressions exhibited by the unconscious person when the tight-fitting mask is lifted off his face to allow the access of air or oxygen. Most frequently we see three types of expression : (1) Anguish and depression ; (2) a serene smile ; (3) a grimace with the mouth partly opened and the teeth bared.

The majority of persons dream during the nitrous oxide-induced unconsciousness, but many forget their dreams almost as they open their mouth to recount them. Erotic dreams are common, but while the patient tries to recall them one can almost see the repressing forces at work. Sometimes fragments are remembered, sometimes only the mood of the dream, and whether it was a pleasant or an unpleasant one, but occasionally the whole elaborate dream is reported. If automatic behaviour occurs during the wakening phase it seems to be an acting out of the dream expressing aggression, flight, or eroticism in a somnambulistic manner.

The dreams often express the patient's immediate problem in a realistic form. One patient was dreaming that she discussed with several people her mental illness and how it prevented her from getting married. Another patient, recovered and waiting for his discharge, dreamed that he was going away somewhere to get work. As the patient improves the dreams tend to become more pleasant. One need not doubt the improvement of the depressed patient who at first dreams of plunging off a cliff and two months later dreams about a jar of cold cream which she had asked the nurse to buy for her.

Manic patients almost invariably have expansive dreams about travelling, exploring, being honoured, or fighting. Depressed patients dream of death and hell; patients suffering from anxiety often have typical dreams of being threatened and chased. Emotional confusion is often expressed by dreams of many people milling around on streets or railway stations. The different symbols, most frequently riding, falling, wild beasts, and water appear frequently. Another type of dream is represented by the appearance of strange abstract masses, shapes, or currents which may be accompanied by a feeling of panic or exultation, A full analysis of a dream under nitrous oxide anaesthesia has been given by Federn (3).

The unconscious reaction of almost all patients to the treatment seems to be so stereotyped that here one feels justified in venturing into the field of symbolic interpretation. The meaning of a treatment is apparently either death or sexual attack. This would explain on a psychological level the decrease of tension and the feeling of relaxation that depressed or anxious patients often experience after the treatment. They have atoned for their guilt with symbolic death or they have experienced instinctual gratification which was permitted by the therapist.

The following cases are presented to illustrate some of the phenomena noted above:

(1) R. D—, aged 19, with catatonic symptoms, whose first manifestations of mental disorder occurred at age 16, following a year's confinement to bed because of rheumatic fever. He had had two previous admissions, during which he received coma insulin and electroshock therapy with remissions lasting six to nine months. On his third admission to hospital after coma insulin and electroshock treatment he presented a picture of deterioration. He was seclusive, retarded, preoccupied and manneristic; he spoke of wanting to become a great scientist without regard for the problems involved. Attempts at psychotherapy were of little avail, as he could not be shaken from his excessive ambitions. It was noted that from his first nitrous oxide treatment he became more spontaneous and sociable. Following the eighth treatment he reported that he had had a dream the details of which escaped him. "It was like we all are," he said, "you know, Mother doing things for you." He went on to tell of how his trouble had started when he was in bed with rheumatic fever and everything was done for him. On previous occasions when this topic had been brought up he had consistently blocked. His improvement was progressive with, however, a persistence of his preoccupation concerning his ambitions. On the occasion of his twentieth treatment he was asked to draw something. Before the treatment he drew a toy which he said he had had when he was in bed with rheumatic fever. After the treatment he drew a clock and remarked that he had set the time at ten minutes to four, which was the time at which he was supposed to return to the ward after being in the hospital grounds. When asked what he thought of the two drawings, he remarked, "I guess I'm getting down to earth." He was then asked to make another drawing. He started to draw the apparatus for the administration of nitrous oxide, but stopped after about 15 minutes, saying that he was tired. He was given the opportunity to continue the drawing on three other occasions. He stopped each time after twenty to thirty minutes, complaining of being tired. On the third occasion he said, "I guess I've started something I can't finish. I guess that's what I've been trying to do all along." From that point onward it was possible to carry on with psychotherapy on a constructive basis. He was able to apply this insight in his plans for the future and adjusted himself accordingly upon discharge.

(2) D. N—, aged 20. A catatonic schizophrenic with hysterical features and paranoid trends. First symptoms occurred at the age of 13. Patient had three

previous hospitalizations treated by coma insulin and electric shock with remissions but poor socialization on each occasion. On his fourth hospitalization, after a further course of insulin treatment he showed little improvement. He remained paranoid and would become extremely excited at even the slightest disturbance in the ward or following visits from relatives. Electric shock therapy produced only temporary and unsatisfactory improvement. Psychotherapy alone was of no avail because of his paranoid delusions centered around homosexual preoccupations and an irrational ambition to become a great musician. Psychotherapy was then combined with nitrous oxide. Following the fifth treatment he threw himself about in a hysterical fashion and was resentful of the therapist. On the eighth he had a dream of obvious sexual connotation and reported that in the dream a man was trying to hypnotize him, but that he managed to turn the tables on him. " It was neither pleasant nor unpleasant," he said. On awakening from his ninth treatment he threw himself on the floor and screamed that he would never get well. Seven hours later he requested an interview and stated that he had been dramatizing, that he had always acted " like a baby who wants milk and has found that he can get it by crying." After two further treatments he spontaneously discussed his homosexual trends and his ambitions in a constructive fashion. Psychotherapy from then on progressed satisfactorily. The patient has been functioning adequately for the past two years.

(3) L. D—, aged 24. University student. Catatonic schizophrenic with acute onset of symptoms. After coma insulin treatment he remained vague and unoccupied. He had repeated bouts during which he became tense and expressed paranoid ideas. These were controlled only temporarily with repeated courses of electric shock. With nitrous oxide treatment and psychotherapy he became sociable, took an interest in occupational therapy and spoke spontaneously of his illness in objective terms. He recognized the futility of his inordinate ambitions and made constructive plans for the future. Now, two years later, he has his own business and is well socialized.

(4) Miss D. F—, aged 35. Anxiety state. From the age of 18 this patient rebelled against an extremely strict up-bringing with sexual promiscuity associated with marked guilt feelings, phobias, obsessive thinking and benzedrine addiction (up to 60 mgm. a day). She had undergone psychotherapy by an outside psychiatrist for four months prior to admission to the out-patient department. Three months of further psychotherapy in the out-patient department produced intellectual insight with no abatement of symptoms. Somnolent insulin gave only transitory relief. She showed a dramatic subjective and objective improvement after a severe outburst of crying on awakening from the sixth nitrous oxide treatment. Psychotherapy in conjunction with one treatment weekly is progressing satisfactorily. Patient is now living at home and shows remarkable ability to integrate her insight and to translate it into positive action on a reality basis.

Though nitrous oxide narcosis is a comparatively simple and convenient procedure, allowing the patient to leave the office unaided a few minutes after awakening without noticeable physical after-effects, it is by no means an indifferent technique as far as the patient's psychological reaction is concerned. To make the person unconscious and cause him to dream means to attack his ego in an uncompromising manner. This technique should therefore only be used by psychiatrists thoroughly familiar with dynamic therapy, since violent fluctuations in the transference situation may occur which are often difficult to control.

It is to be noted that the psychotherapy used by the authors with nitrous oxide treatment was of a strictly non-directive nature. This is emphasized because active probing into apparently stable insights may disturb the patient in an alarming manner.

It is frequently not recognized that there is a distinct difference in the administration, effects and therapeutic goals between narcosis induced by the intravenous injection of barbiturates and narcosis produced by the inhalation of gases, either nitrous oxide following the technique described by the authors or carbon dioxide as discussed recently in several excellent papers by Meduna and his co-workers (4). Intravenous narcosis aims at the alteration of a state of consciousness rendering the patient more accessible, more communicative, less inhibited, but at the same time his intellectual functions are retarded and possibly clouded. Nitrous oxide therapy aims at a rapid and complete loss of consciousness followed by rapid awakening without retardation or clouding of the intellectual functions. This technique, unlike Rogerson's (5), is not primarily aimed at obtaining new material from the patient. If such is produced this is done while the patient is in full possession of his conscious faculties, not showing any impairment of the functioning of his ego, but rather increased alertness and confidence as well as facilitation of associative processes. The main accent with this treatment lies on the assimilation of material which may already be known to therapist or patient.

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"REGRESSIVE" ELECTROPLEXY IN SCHIZOPHRENICS.

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[Received 7 November, 1949.]

It is generally accepted that deep insulin coma therapy is the treatment of choice for patients suffering from schizophrenia. A certain proportion of patients treated do not respond favourably to this form of therapy (in our series 23 per cent. of cases), and the question remains whether there are any alternative methods that would have a beneficial influence on such insulin failures. We were also anxious to find some treatment for such chronic cases that were not considered sufficiently promising for coma treatment.

Encouraged by the favourable results with "regressive electric-shock in schizophrenics refractory to other shock therapies," obtained by C. J. C. Kennedy and D. Anchel (1948), we decided to investigate the possibility of applying this method, to the above-mentioned type of case. It should be clearly understood that "regressive" electroplexy is definitely different from what W. L. Milligan (1946), and M. Valentine (1949) among some other authors have described as intensive electroplexy. It was our aim from the onset to get the patients regressed to such an extent that they became mute, incontinent and unable to take their food without spoon-feeding. We started, following the method described by Kennedy and Anchel, with two to four convulsions daily, but found soon that such a small number of convulsions per day, and twenty to thirty treatments altogether were not sufficient to obtain full regression.

As we had fully realized from the onset that this method of physical treatment cannot be without considerable risks we had all prospective patients carefully examined. We commenced treatment only after satisfactory X-ray examination of chest and spine, chemical and microscopical examination of urine, and full blood investigation (number of erythrocytes and leucocytes, haemoglobin, colour index, differential blood count, and blood sedimentation rate). Only patients found physically healthy were accepted for the treatment. In the light of our experiences we consider an electrocardiogram as an advisable additional precaution.

We used for the induction of the convulsions a MacPhail-Strauss Electro-Convulsant Unit, with a fixed time mechanism, and a convulsant voltage radius from 70 to 150 volts. Our initial voltage was usually 85 volts. A lower voltage was, as a rule, insufficient to induce a convulsion. The threshold was frequently so considerably increased that it was found necessary to increase the voltage for almost every subsequent convulsion. It was quite a common occurrence that the voltage had to be increased by five to ten volts in every treatment, with the result that the first convulsion at 8.30 a.m. was induced with, say, 85 volts, and the seventh and last one at about 2.30 p.m. with up to 150 volts. The interval between two treatments was thirty to sixty minutes. In addition to the usual precautions, we used a rubber pessary ring as a gag. This type is most useful, because it can be comfortably fixed between the molars.

We were able to achieve full regression in all but four patients (Nos. 9, 11, 12 and 18 of the Table), in whom the clinical symptoms made it imperative to terminate the treatment before sufficient regression had been achieved. Several patients became fully regressed with a fairly small number of convulsions spaced over a few days, whereas other patients required a great many convulsions spread over up to thirteen days for what we considered full regression. Most of the patients became confused after two days' treatment, and after four to six days they were unfit to take food, except fluids such as milk with egg. Thiamine hydrochloride, 13 mgm., riboflavin, 3 mgm., and nicotinic acid, 50 mgm., were added. The loss of weight was considerable in all but one patient. The treatment was terminated when the patient was in a state of complete confusion and utter apathy, mute, incontinent and unable to take food without assistance.

The nursing of the patients was no easy task, and taxed the nurses considerably. Constant attention to all pressure points was necessary to avoid bed-sores, and we would like to put on record that not a single patient had such lesions.

We were amazed to see how quickly, namely, after three to five days, most of the patients recovered from their poor state of nutrition and regained control of anal and urethral sphincters. After the physical recovery the state of confusion and apathy subsided within four to thirteen days from the termination of the treatment.

All patients treated showed florid psychotic features. After their recovery from the state of confusion and apathy the hallucinations and delusions were hardly or not at all in evidence, and most patients were somewhat more co-operative and better conducted than before the treatment. However, only a few were fit for a psychotherapeutic approach, and in spite of vigorous efforts all but two patients slipped back into their more or less chronic psychoses very soon after the termination of the treatment. These remaining two patients (Nos. 3 and 6) relapsed several months later.

In view of the considerable risks of the treatment only cases that had an otherwise hopeless prognosis were selected for it *i.e.* chronic schizophrenics with a gross conduct disorder, or more recent schizophrenics who had not responded to other methods of treatment, such as deep insulin coma therapy, prefrontal leucotomy, etc.

The table summarizes the following points:

"Regressive" electroplexy was given to ten male and eight female patients. The youngest was 24 and the oldest 51 years old. Their average age was $30\frac{5}{12}$

TABLE.

Number of case. (1)	Sex. (2)	Age. (3)	Years in hospital. (4)	Duration of psychosis (years). (5)	Previous treatment. (6)	Number of "regr." E.C.T. (7)	Duration of treatment (days). (8)	Duration of recovery (days). (9)	Loss of weight (lb.). (10)	Psychotic condition. Before treatment. (11)	Psychotic condition. Nine months after treatment in all cases but Nos. 3 and 6. (12)	Complications. (13)	Remarks. (14)
1	M.	25	3	3	Ins.	49	11	5	21	H.U.	c	Rise of temp. 7 ×	—
2	M.	25	3	3	E.C.T., Ins.	49	11	5	11	S.U.	c	Rise of temp. 8 ×	—
3	M.	24	5	6	E.C.T., Ins.	75	13	4	18	H.U.	a*	Rise of temp. 7 ×	Readmitted to hospital 8 months after termination of treatment.
4	M.	28	4	4	E.C.T., Ins., Eln., Leuc.	80	13	13	16	H.D.U.	d	Rise of temp. 9 ×	—
5	F.	25	8	8	E.C.T., Leuc.	68	8	5	10	C.H.U.	c	Rise of temp. 5 ×	—
6	M.	24	1	$1\frac{7}{12}$	Ins.	53	6	7	10	C.H.D.U.	a**	Rise of temp. 6 ×	Readmitted to hospital 7 months after termination of treatment.
7	F.	25	4	6	E.C.T.	64	8	13	10	H.U.	b	Rise of temp. 6 ×	—
8	M.	28	3	5	E.C.T., Ins.	70	8	9	21	H.U.	b	Rise of temp. 6 ×	—

9	M.	28	2	4	E.C.T., Ins., Leuc.	47	6	—	—	H.U.	—	Rise of temp. 6 × cardiac failure, bronchitis	Died 3 days after termination of treatment.
10	M.	28	5	6	E.C.T., Ins.	47	6	7	19	H.U.	c	Rise of temp. 6 ×	— —
11	F.	40	8	18	E.C.T.	38	5	—	—	H.	c	Rise of temp. 5 ×, bronchopneumonia	—
12	F.	22	4	4	E.C.T., Leuc.	40	5	—	—	H.U.	b	Rise of temp. 5 ×, bronchopneumonia	—
13	M.	24	1	$1\frac{1}{12}$	Ins.	51	8	11	18	C.H.U.	c	Rise of temp. 5 ×	—
14	M.	34	10	11	Ins., Leuc.	51	8	7	18	H.U.	c	Rise of temp. 5 ×	—
15	F.	51	2	?	E.C.T.	64	12	8	6	C.H.U.	c	Rise of temp. 8 ×	—
16	F.	43	25	27	E.C.T.	67	12	8	11	H.U.	c	Rise of temp. 8 ×	—
17	F.	45	28	28	E.C.T., Leuc.	62	9	6	1	H.U.	c	Rise of temp 5 ×	—
18	F.	29	11	12	Card., E.C.T., Ins.	34	4	—	—	H.U.	—	Rise of temp. 4 ×, bronchopneumonia	Died 3 days after termination of treatment.

Ins., deep insulin coma therapy; E.C.T., electric convulsion therapy; Eln., electronarcosis; Leuc., prefrontal leucotomy; Card., cardiazol shock therapy. H., Hallucinations; D., delusions; C., confusional state; S., stupor; U., unemployable. a, Socially recovered and discharged; b, somewhat improved and employable under supervision in hospital; c, not improved; d, deteriorated. * Examined when departing 2 months after termination of treatment; ** 4 months after.

years. The shortest stay in hospital was one and the longest was 28 years. The average stay in hospital amounted to 7 years. The duration of the psychosis ranged from $1\frac{4}{12}$ to 28 years, and the average duration was $8\frac{7}{12}$. Between 34 and 80 convulsions were required to obtain sufficient regression with an average of 56 convulsions. The treatment was spaced over 4 to 13 days, and the average treatment took $8\frac{1}{2}$ days with almost 7 convulsions per treatment day. One female patient (No. 17) lost only 1 lb., whereas 2 male patients (Nos. 1 and 8) lost no less than 21 lb. in the course of not much more than one week. The average loss of weight was 13 lb. 9 oz., but one has to take into account that the patients were not fit for weighing in the first two or three days after termination of the treatment. Some patients recovered physically within four to six days, whilst some others required eleven to thirteen days for their physical recovery.

All 18 patients had pyrexia between 99° and 101° F. very frequently in the afternoon and evening. In most cases the temperature returned to normal during the night. The treatment was continued the following morning only when the temperature was within normal limits again. The cause of the pyrexia is unknown to us, but it is conceivable that the rise of temperature is attributable to a process similar to the mechanism causing the pyrexia in *status epilepticus*.

In order to avoid undue dogmatism in the classification of schizophrenic psychoses, and as the number of patients treated was rather small, it will be sufficient to state that all 18 patients suffered from schizophrenia. Almost all of them were hallucinated, and all were unemployable. None of them had favourably responded, at least not for any length of time, to ordinary electroplexy, cardiazol shock therapy, deep insulin coma therapy, electronarcosis, or prefrontal leucotomy. Only two male patients (Nos. 3 and 6) improved considerably for a time and were able to depart as socially recovered, but they had to be readmitted to this hospital quite recently with florid schizophrenic manifestations. One male (No. 8) and two female patients (Nos. 7 and 12) are still showing some improvement, and have become employable under supervision in hospital. Five male and five female patients show no change, and one male patient (No. 4) has steadily deteriorated.

One male patient (No. 9) died three days after termination of the treatment, and death was attributable to extensive fatty changes in the myocardium and atheroma of the coronary arteries and aorta, uncommon findings in a young man of 28 years of age. The post-mortem examination had also revealed a bilateral bronchitis. The pathological findings in the myocardium and arteries were confirmed histologically. One female patient (No. 18) died three days after early, immediate termination of treatment when the first clinical symptoms of bronchopneumonia on the left side had been detected. The post-mortem examination confirmed the clinical diagnosis. Extensive pleural adhesions on the right side were also found which had not been revealed by the X-ray photo of the chest taken prior to the commencement of the treatment.

Two female patients (Nos. 11 and 12) developed mild bronchopneumonia a few days after premature termination of the electroplexy therapy.

Some biochemical examinations were carried out in five cases.

Case 9.

C.S.F.:	Sugar	100	mgm.	per	100 c.c.
	Chlorides	882	,,	,,	,,
	Proteins	30	,,	,,	,,

These estimations were made about 24 hours before death.

Case 11.

Urine:	Chlorides	880	mgm.	per	100 c.c.
C.S.F.:	Sugar	66	,,	,,	,,
	Chlorides	732	,,	,,	,,

These results were obtained on the sixth day after termination of the electroplexy, when the patient showed some clinical signs of bronchopneumonia.

Case 12.

Urine:	Chlorides	995	mgm.	per	100 c.c.
C.S.F.:	Sugar	67	,,	,,	,,
	Chlorides	730	,,	,,	,,

Also this patient had a mild bronchopneumonia, and the examinations were carried out on the sixth day after the discontinuation of the electrically induced convulsions.

Case 15.

Blood chlorides	485	mgm.	per	100 c.c.	(*a*).
	462	,,	,,	,,	(*b*).
	457	,,	,,	,,	(*c*).

(*a*) Before, (*b*) on seventh day of, (*c*) one day after termination of treatment.

Case 16.

Blood chlorides	485	mgm.	per	100 c.c.	(*a*).
	471	,,	,,	,,	(*b*).
	442	,,	,,	,,	(*c*).

(*a*) Before, (*b*) on fifth day of, (*c*) one day after termination of treatment.

Case 9 showed abnormally high chlorides (and an increased amount of sugar) in the cerebrospinal fluid, but as the chlorides in the blood were not examined at the same time, it is not possible to give an interpretation of this isolated abnormal value. Following these findings chlorides in urine and c.s.f., and sugar in c.s.f. were examined in two patients with mild bronchopneumonia (Nos. 11 and 12). Serial blood chlorides were estimated in two more cases (Nos. 15 and 16). The examinations in Cases 11 and 12 did not reveal anything abnormal. A steady decrease of the blood chloride values during and after treatment was found in Cases 15 and 16. Interesting as these findings in the two last mentioned cases are, it appears to be impossible to give a definite interpretation without further investigations. A cause might be dehydration of the patients. They lost considerable weight while under treatment, and therefore a certain degree of dehydration cannot be excluded. Since the chlorides were estimated in the whole blood (r.b.c. plus plasma), a relative increase in the number of r.b.c. might account for a gradual comparative decrease of the chlorides.

It is obvious that our unfavourable results are in marked contrast to the achievements published by Kennedy and Anchel. This difference is all the more remarkable as they were apparently able to get their patients sufficiently regressed with fewer convulsions on the average. On the other hand, we have to mention that the average duration of psychosis was 4½ years in their series of 25 cases, whilst it was more than 8½ years in ours. We found that a number of our patients were somewhat more co-operative for a few days after their recovery from their confusional state, but we cannot confirm that "their minds seem like clean slates upon which we can write," and we were not "able to steer them back to reality and away from their psychotic thinking," to quote Kennedy and Anchel themselves. We have made such observations in cases of early schizophrenia in the course of deep insulin coma therapy, but never in our series of patients treated with "regressive" electroplexy.

Conclusions.

(1) "Regressive" electroplexy had no lasting beneficial effect on eighteen schizophrenic cases treated. Eleven cases (nine fairly recent, two chronic) had had insulin coma therapy without any lasting subsequent improvement, while the other seven were chronic schizophrenics who had not had insulin treatment.

(2) This form of physical treatment is not only difficult to carry out, but also involves considerable risks.

(3) In the light of our experiences we have discontinued the use of "regressive" electroplexy.

I should like to express my thanks to Dr. D. Macmillan, Medical Superintendent, who encouraged me to carry out this clinical investigation, Dr. W. Fabisch, who kindly performed the biochemical and histological examinations, and the nurses who devoted themselves to the difficult nursing of the "regressed" patients.

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A COMPARISON OF PERSONALITY-TRAITS OF SCHIZOPHRENIC PATIENTS BEFORE LEUCOTOMY.

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[Received 7 January, 1950.]

Introduction.

When we compare the personalities of two or more individuals we should know whether traits we notice are also noticed by others, and whether such traits are common or rare. To obtain this information we must be able to compare the traits noticed by one observer with those noticed by others. We must also be able to compare the traits reported of one individual with those reported of others. Both comparisons must be made systematically and quantitatively. A method of doing this has been developed ([1]). It was employed by Frankl and Mayer-Gross ([2]) to assess the typical personality-traits of a group of patients all of whom had finally recovered after prefrontal leucotomy to the extent of their being discharged from hospital. It seemed profitable to study a sample of the same patients during the period of their psychosis, and to compare the personality-traits noted before and after the operation.

This paper describes the technique used and the problems encountered. It is intended to illustrate the merits and limitations of the method. Results of greater validity and significance would be forthcoming only from a larger investigation.

Method.

Selection of sample.—Twenty cases were selected from a group of 68 post-leucotomy patients already studied by Frankl and Mayer-Gross ([2]). This sample was made as homogeneous as possible as regards diagnosis and age, and was equally divided as regards sex. Ten men and ten women, all diagnosed as schizophrenic, and all aged between 20 and 40, constituted the group finally chosen for study. All these were long-standing cases observed over a period of years, and in this sense constituted a selected group which showed features which were more distinctive than would otherwise have been the case.

Preparation of data.—The data used in this investigation were the case-histories. These consisted of statements describing observed traits selected for record during a series of interviews, in many cases made by more than one medical officer. The first problem was to abstract from these data a personality-description of each patient over the period of his illness up to the time of the operation, and to present it in a form suitable for comparative study.

In order to assess the degree to which the personality of the observer influences the description made of another person, it was decided that separate personality-descriptions of each of the 20 cases should be written independently by two reporters, one a man, and one a woman. (The writers of the paper.) Each personality description was kept as short as possible consistent with giving a clear picture of the patient, and it was, in fact, possible to maintain an average of 16 separate and distinct statements in each. The two reporters were careful to avoid discussion of the cases, either with each other, or with the medical officers. An attempt was made to avoid the use of technical terms.

Comparison of statements.—By comparative matching ([1]), the 40 personality-descriptions were compared for differences attributable to the reporter on the one hand, and to the patient on the other. It was thus possible to assess those traits which were more often noted by one observer than by the other, and those which could be regarded as typical of the group of patients studied. The method consisted of writing every distinct statement from every personality-description onto a separate card. Each card was indexed to show the sex and group number of the patient to whom the statement on the card referred, and to show which of the two reporters had noted the trait. The cards were then sorted, ignoring the index marks, so that those bearing similar statements were grouped together. No assumptions whatever were made as to the type of statement which should constitute each group, the nature of the groups emerging only from an inspection of the statements themselves. It became clear that the first division would have to be made between what the patient said about himself and what was said about him by others. The latter group of statements were found to deal with his history, his appearance, his mood and how he conversed. The former were found to deal with statements that he could not think clearly, that he believed he was being watched and persecuted, that people and things seemed different, that he was being influenced and that he heard voices speaking to him or referring to him. The final groups arrived at are listed in Table I.

RESULTS.

Having sorted the cards into groups, they can be assessed either qualitatively by reading the statements on them, or quantitatively by counting the number in each group. By counting them we can assess differences between the reporters, sex differences between the patients, and the typical traits reported; and we can compare traits before and after leucotomy. By reading them we can compare the actual statements made by the patients themselves.

Differences between the reporters.—Of the total 643 statements made, 21 per cent. were recorded by one reporter alone (indexed H); 25 per cent. by the other alone (indexed W); the remainder were reported by both (Table II). The relative frequency with which similar statements were made by the two reporters indicates where they agree and where they differ. In comparing the two reporters' statements, only those made more than ten times were considered. The difference between the two reporters was taken to be significant when similar statements were made at least twice as often by one as by the other. The most striking difference between the two reporters was found to be that out of 46 statements made about the patients' appearance, 44 were made by W and only two by H (Table I). This trait is not therefore any the less significant. Such variations arise from differences in the personal interests of the reporters, and in the extent and nature of the training they have received. Four traits were reported at least twice as often by W; that as a child the schizophrenic was normally healthy and intelligent, but quiet, reserved and self-centred; that he failed to pursue a regular occupation, and that in mood he seemed aloof and detached. Almost twice as often as H, W reported that the schizophrenic patient says that people and things seem different. Out of the 27 statements concerning the onset of the illness, however, 22 were made by H, and only 5 by W. In addition, H reported more than twice as often as W that the schizophrenic took up a normal occupation, and almost twice as often that he is impulsive, violent and difficult to manage. In all other data there was close agreement between the number of statements describing any trait made by the two reporters.

Sex differences between the patients.—Five of the ten men studied had broken down under war strain. Apart from this, no trait was reported exclusively of

TABLE I.

	Number of statements made by the reporters.			Number of patients of whom the statements were made.		
	W.	H.	W+H.	M.	F.	M+F.
It is said of the patient that—						
From the outset—						
Other members of the family are mentally abnormal	1	6	7	3	3	6
He was injured at birth	—	2	2	—	2	2
	1	8	9	3	5	8
In youth—						
He had fits	1	2	3	—	2	2
He was brought up strictly	1	—	1	—	1	1
He was brought up indulgently	2	1	3	2	1	3
He did well at school	**7**	**8**	**15**	6	3	9
He did not do well at school	3	5	8	2	3	5
He was normally healthy and intelligent	**10**	**5**	**15**	**6**	**5**	**11**
He was sociable	8	2	10	4	4	8
He was quiet, reserved and self-centred	**10**	**2**	**12**	**6**	**4**	**10**
He was "nervous"	3	3	6	1	3	4
He was moody	2	1	3	—	2	2
He took up a normal occupation	**7**	**15**	**22**	**8**	**8**	**16**
There was a change in his temperament	**9**	**8**	**17**	**4**	**7**	**11**
He failed to pursue a regular occupation	**10**	**5**	**15**	**3**	**8**	**11**
He was conscientious	2	—	2	1	1	2
He worried over masturbation	1	—	1	1	—	1
He had a traumatic experience	—	1	1	—	1	1
He threatened suicide	1	4	5	2	2	4
	77	62	139	46	55	101

TABLE I—*cont.*

His mental illness began—							
Under strain	4	5	9	.	5	—	5
Insidiously—with periods of abnormality	**1**	**16**	**17**	.	**6**	**10**	**16**
Suddenly	—	1	1	.	1	—	1
	5	22	27	.	12	10	22
In appearance—							
He is handsome, bright and cheerful	8	1	9	.	5	3	8
He is dark-haired	6	—	6	.	2	4	6
He is tall and thin	8	—	8	.	4	4	8
He is immature	5	—	5	.	2	3	5
He is ill-nourished	4	—	4	.	2	2	4
He is untidy	6	1	7	.	3	3	6
He has some striking feature	6	—	6	.	3	3	6
He looks older than his age	1	—	1	.	—	1	1
	44	**2**	**46**	.	21	23	44
In mood and conduct—							
He is well-mannered and co-operative	3	3	6	.	3	1	4
He is not moody	—	2	2	.	2	—	2
He is moody	1	1	2	.	—	1	1
He lacks concentration	3	1	4	.	3	1	4
He is aloof and detached (dis-interested)	**15**	**7**	**22**	.	**8**	**8**	**16**
He is apathetic	1	7	8	.	3	4	7
He is bemused	7	2	9	.	2	5	7
He is dejected and depressed	5	4	9	.	1	5	6
His mood is incongruous	—	6	6	.	2	4	6
He is suspicious	1	3	4	.	2	1	3
He is anti-social and aggressive	4	3	7	.	3	3	6
He is restless	**5**	**8**	**13**	.	**8**	**2**	**10**
He is elated	2	2	4	.	2	—	2
He is frightened and worried	1	3	4	.	2	1	3
He is tense	5	5	10	.	4	2	6
He is impulsive, violent and difficult to manage	**6**	**11**	**17**	.	**5**	**6**	**11**
He has obsessional traits	—	1	1	.	—	1	1
He has odd habits	**9**	**10**	**19**	.	**7**	**5**	**12**
He contorts his face	**10**	**9**	**19**	.	**8**	**4**	**12**
He giggles and mutters to himself	**10**	**8**	**18**	.	**5**	**6**	**11**
He has flights of ideas	—	1	1	.	1	—	1
He has delusions	—	1	1	.	1	—	1
	88	98	186	.	72	60	132
In conversation—							
He talks easily	**9**	**12**	**21**	.	**7**	**5**	**12**
He appears to think clearly and rationally	1	5	6	.	3	2	5
He talks coherently	4	2	6	.	4	1	5
He is full of doubts	2	1	3	.	2	1	3
He is unproductive	2	3	5	.	3	2	5
He talks with difficulty	**11**	**13**	**24**	.	**6**	**8**	**14**
He is uncommunicative	**7**	**7**	**14**	.	2	5	7
He talks incoherently	**8**	**11**	**19**	.	**8**	**6**	**14**
He is vague or evasive	2	4	6	.	2	2	4
He uses circumlocutions	1	—	1	.	1	—	1
He uses neologisms	1	1	2	.	—	1	1
He appears to speak to voices	—	2	2	.	—	2	2
	48	61	109	.	38	35	73

TABLE I—*cont.*

The patient says—						
There is nothing wrong with him	4	5	9	4	3	7
He thinks there is something wrong with him	—	2	2	1	1	2
He failed to develop and is inadequate	5	1	6	3	2	5
He has no interest in the future	2	1	3	2	—	2
He is depressed, lonely	5	1	6	2	3	5
He is preoccupied with ideas of life, death and religion	3	1	4	—	3	3
He cannot think clearly	**8**	**4**	**12**	4	4	8
He feels electric shocks	1	1	2	1	—	1
He believes he is being watched and persecuted	**6**	**8**	**14**	**5**	**5**	**10**
People and things seem different	**10**	**7**	**17**	**6**	**6**	**12**
He thinks he is being influenced	**8**	**7**	**15**	**5**	**5**	**10**
He doesn't hear voices	2	2	4	2	1	3
He hears voices speaking to him or referring to him	**10**	**9**	**19**	**5**	**7**	**12**
He sees visions	3	2	5	1	3	4
He has significant dreams	—	1	1	—	1	1
He thinks about dirt and drains	1	1	2	—	1	1
He is very important	1	—	1	1	—	1
He feels tense	1	1	2	1	—	1
He objects to treatment	—	2	2	1	1	2
He cannot work	1	—	1	1	—	1
	71	56	127	45	46	91
Grand Total	334	309	643	237	234	471

The traits printed in *italics* were those found to be typical of the group under discussion.

The figures in heavy type in the first column denote those trait-frequencies which were used to compare one reporter with the other.

The figures in heavy type in the second column denote the frequencies of those traits which were typical of the group of patients studied, and which were used to compare one sex with the other.

TABLE II.—*Frequencies with which groups of traits were recorded by the two reporters.*

	Total number of observations.	W alone.	%.	H alone.	%.	Both.	%.
It is said of the patient that—							
From the outset	9	—	—	7	78	2	22
In youth	139	39	28	24	17	76	55
His mental illness began	27	—	—	17	63	10	37
In appearance	46	42	91	—	—	4	9
In mood and conduct	186	34	18	44	24	108	58
In conversation	109	12	11	25	23	72	66
The patient says—	127	35	28	20	16	72	57
Totals and percentages	643	162	25	137	21	344	53

one sex more than twice (Table I). Only statements made of at least 10 of the 20 patients were considered for the purposes of comparison. The difference between the sexes was taken to be significant if a given trait was reported of one sex at least twice as often as of the other. It was reported of men at least twice as often as of women that they were restless, and that they showed contortions of the face. Of women it was reported at least twice as often as of men that they failed to pursue a regular occupation, and that there was a change in their temperament, their mental illness beginning insidiously.

From the data it would appear that there are no great differences between the sexes in schizophrenia. The male patients who had broken down under the strain of war service were at an earlier stage of the illness, when restlessness is a more prominent feature. The failure to pursue a regular occupation reported more often of the women patients may reflect a somewhat lesser need for women in general to choose one occupation to be followed throughout life, and a tendency to regard any job other than marriage as a more or less temporary one.

Typical traits reported.—As there seemed to be no important sex differences, the 10 men and 10 women were regarded as forming a single class of schizophrenics. Again considering those traits which were reported of at least 10 of the 20 patients, and not exclusively by one reporter, it was possible to build up a composite picture of the personality typical of the group of schizophrenics studied. It appeared that, as a child, the typical schizophrenic was normally healthy and intelligent (11)*, but tended to be quiet, reserved, and self-centred (10). On leaving school, he took up a normal occupation (16), but there was a change in his temperament (11), and he was unable to pursue his occupation (11). His mental illness began insidiously, with periods of abnormality (16). In mood he is aloof, detached and disinterested (16). He is often restless (10), and sometimes becomes impulsive, violent and difficult to manage (11). He has odd habits, such as rubbing his hands, gesticulating, looking sideways and collecting rubbish in his pockets (12). He contorts his face, scowling, grimacing or smiling fatuously (12). He giggles and mutters to himself (11). At times he talks easily and fluently, answering questions readily (12), but more often his speech is halting, abrupt and disjointed (14). He is often incoherent, making irrelevant and inconsequential remarks (14). He says that people and things seem different (12), and believes he is being watched and persecuted (10). He hears voices speaking to him or referring to him (12). He thinks he is being influenced by some person or power outside his own body, by electricity, or by wireless (10).

Of the 19 traits reported as being typical of the group studied, only 5 could be said to be highly typical, namely: that he took up a normal occupation, there was an insidious onset of illness, he became aloof, his conversation becoming disjointed and irrelevant. The less typical traits reflect the considerable variability in the form which the illness takes. This is further reflected in the 64 other groups of traits noticed which were not typical of the group as a whole.

Patients' statements about themselves.—The independent statements made by the patients themselves could be used to make a qualitative study of the kinds of thought disorder occurring in the group of schizophrenics studied. It was possible to bring together and to compare the patients' statements in order to show their common qualities, and the degree to which they elucidated and amplified one another. Although each statement is characteristic only of the particular patient who made it, together they illustrate the range of thought disorder occurring in the group studied. The schizophrenic patient says there is nothing wrong with him, that his experiences are not an illness but are actual facts. He is in hospital to learn " double talk," but if this is not possible (i.e., if the doctors cannot teach him) then perhaps to stop worrying about it. He feels inadequate and immature. He feels frustrated because somehow his life has gone wrong and he has failed to develop. He does not know what to do with himself. He has no goal in front of him. He feels despondent, and sometimes cries when he is alone. He thinks he has done something wicked, and is preoccupied with ideas of life, death and religion. He refuses to eat, saying : " Why should I feed my body when my soul is dead ? "

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* The figures in parentheses indicate the number of patients out of the group of 20 of whom the trait was reported.

He cannot concentrate on books ; he feels lazy, and sometimes his thoughts stop and he feels he cannot go on thinking. Everything is in a muddle ; he feels constantly tired, but he says that this is purely a mental feeling. He suffers from frontal headaches, as if someone were hacking into his brain. There is a funny sensation in his head of interference. He feels electric shocks going through his body. He thinks he is being tortured and is going to die. Neighbours hear everything he says and they watch him. People laugh at him and make remarks about him. There is a plot to keep him shut up in hospital. His food is poisoned by people who are trying to do him harm. He feels he is among enemies whom he can spot by merely looking at them.

He is in a dream-state, and everything is changing in colour and appearance. Nothing seems real ; his sense of values seems to have turned upside down. He says that he has a tin heart, and that he now has someone else's brain which is inferior to his own. He thinks his soul is a stone at the bottom of the sea. He dreams of his mother as a statue. His mother is a vampire who is trying to change him into an animal. He accuses his brother of being Hitler, and his wife of being a German spy. Other patients at the hospital look like foreigners. He thinks he is being led by some external power ; things influence his mind. He is influenced by atomic rays. Someone is acting on him from a distance ; people are influencing his ideas and he has a weak mind which makes this possible. He feels it is not himself speaking, but someone else speaking through him. He is handled by some power other than his own body, but he has terrific confidence in a small band of people tucked away in some corner of the world. He interprets advertisements in the newspapers as referring to him. The wireless is talking about him and giving him messages and instructions.

He hears his own thoughts repeated in his head. He hears voices. It is all the family saying things. There is no cancer and there is no cure. Other people's thoughts are talking to him. He thinks the stars are talking to him and that he is a star himself. He sees visions and things coming at him, but cannot always make out what they are. He saw a lot of devils—they shrieked and shrieked bells—you just feel as if you'd been whipped afterwards.

Comparison of traits noted before and after leucotomy.—Finally, it was possible to compare the typical schizophrenic personality before leucotomy with the typical traits reported of him after the operation.* For this purpose the description of the typical post-leucotomy personality obtained by Frankl and Mayer-Gross (²) was divided into separate and distinct statements. Each of these was then compared with the groups of statements describing the schizophrenic patients before the operation. Where the same trait was reported of more than five patients before the operation, it was considered to have remained unchanged. Where a similar trait was reported only once, or not at all, before the operation, it was considered that a change had occurred. The comparison showed that, *like* the schizophrenic patient before leucotomy, the typical patient discharged after the operation is described as restless (10)†. He may be self-willed and headstrong (11). He tends to quickly passing outbursts of temper (11). His relations to people around him are without depth of feeling (7). He shows little sympathy or consideration for his next-of-kin or for anybody else (6). He is unable to see the other's point of view (6). He neither regrets nor repents for whatever he may have said or done (6).

Unlike the schizophrenic patient before leucotomy, he does not worry. He is happy and contented, and shows it. He has a marked feeling of well-being. His prevailing mood is cheerfulness. He has a high opinion of himself and his abilities. He leads an active life and likes movement and change. His interests and hobbies are varied and variable. He is easy-going, a good mixer, fond of social life and of being on good terms with everybody.

If the results obtained are correct, it would appear that the operation, removes tension and worry, and abnormal organizations of thought, and makes the patient a cheerful and active person. It does not appear to affect the self-centred and self-willed lack of consideration for others, nor does it appear to make good the emotional deficiencies of the schizophrenic.

COMMENTS.

1. In all personality-studies the ultimate source of data is the particular person or group of people under review. The problem is how to observe, record and compare the data obtained in such a way that it is influenced as little as possible by the method used, and where such influence does occur, to be able to estimate it.

Since personality-descriptions of the patients were written by both reporters from data recorded in the case-histories, the data available were precisely the same for each. The only variable thus operating was the personality of the reporter. The differences noted between the two sets of personality-descriptions demonstrate that different people select different items from the same presented data.

If differences occur in these circumstances, a substantially greater degree of divergence might be expected when the personality-description is made directly from data recorded during a personal interview with the patient. In this case the source of data is no longer a case-history which remains unaltered by examination. The source of data is now the end-product of the interaction of the personalities of the patient and the interviewer. As has already been mentioned, the proximate source of data in this investigation was the case-history, the interaction referred to having already taken place between the person interviewed and the medical officers compiling the case-history.

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* It should be pointed out that the group of 68 patients discharged after leucotomy contained 17 who were not diagnosed as schizophrenic. Therefore the post-leucotomy picture is derived from a predominantly, but not wholly, schizophrenic group.

† The numbers given in parentheses indicate the number of pre-leucotomy patients who showed the same trait.

2. In separating statements which occur in the same personality-description, certain striking combinations of traits tend to get lost, which, when together, are significant, but when separated become commonplace. For example, whereas it would scarcely be noteworthy that a man wore a bowler hat, or that he wore a pair of shorts, it would be of interest to learn that he wore both at once. This difficulty is overcome if care is taken to transfer unitary observations to the cards rather than unitary statements. Thus in the example cited above, what is observed is that a man wore a bowler hat *and* a pair of shorts; had either been observed separately, it is probable that neither would have been thought worth recording.

3. The method used in this investigation moulds its own system of classification, and provides the basic data upon which a punched card system or questionnaire could be built. Usually such a system or questionnaire is evolved intuitively; this method makes it possible to do this explicitly. The method under consideration has the advantage that descriptive details are not lost in the process, as they are when a statement is put into a group with a predetermined title, and regarded thereafter as simply a quantitative addition to that group. The names of groups are merely convenient labels, the meanings of which are amplified by the statements in the group to which each refers. The group-names are assigned only after the cards have been matched and sorted. Each name results from an inspection of the material in its group. Having sorted the cards there are always a certain number that will not fit anywhere. Some of these would probably fall into small groups if the sample were larger, and in any case provide valuable material for qualitative study.

4. In the case of personality-descriptions based on answers to a questionnaire, the material consists of responses to definite predetermined stimuli. Information is provided on every point about which a question is asked for every case under review. The personal interests of the person asking the questions are not involved to any great extent, unless he has assisted in drawing up the list of questions asked. As the questions can be, and often are, given in the form of a written pencil and paper test, the reactions between the personalities of the questioner and the person questioned can be minimized. At the same time the information obtained is restricted both by the form in which the questions are put, and the topics with which they deal.

In the case of personality-descriptions based on statements abstracted from case-histories, the people making the descriptions are provided with the information which appeared of interest and significance to the clinicians compiling the histories. At the same time the people abstracting the case-histories will select only those statements of interest and significance to them.

In the case of personality-descriptions based on observations recorded at an interview, the description is influenced by the person making it, both from the fact that he selects for record only those items which appear of interest and significance to him, and from the fact that the impact of his own personality on the personality he is observing will modify the latter and determine those traits available for observation and record.

In the case of personality-descriptions based on an interview, it is possible for hitherto unconsidered traits to be observed and recorded. The method described facilitates both recording such traits and retaining them for systematic comparative study. At the same time it makes it possible to assess the influence of the observer's own personality upon the description he prepares.

5. The method used also makes it possible to divide the subjects studied according to any convenient criterion, and to compare the classes so formed in order to determine what, if any, characteristic features are found to distinguish the one class from the other. In the present investigation the subjects were divided according to sex, and it was found that, at least in the cases studied, the illness appeared to take the same form both in men and in women. In a more exhaustive investigation the people studied could be divided in accordance with any particular clinical feature or test result, and it would be possible to determine the characteristic traits observed in each class. In this way it is possible to assess the degree to which in any given class one clinical feature is associated with another clinical feature, or the degree to which any given test is diagnostic of the illness as a whole, or of the particular forms it tends to take.

Conclusion.

In his book on *Projective Techniques*, Bell(³) states :

> "Studies that isolate traits from their contexts in the Gestalt of the whole record distort the significance of those items ; those that only compare wholes, as by matching, are deficient in failing to measure the significance of detailed individual items to the total picture. New statistical devices are urgently needed for solving these complex and pressing problems. . . ."

It is suggested that the method described in this paper may be a contribution to the solution of these problems.

Our thanks are due to Dr. P. K. McCowan, Physician Superintendent of the Crichton Royal, for permission to study the case-histories ; to Dr. W. Mayer-Gross for information and advice on the psychiatric aspects of the research, and to Mr. J. C. Raven, under whose direction the work was done, for valuable advice and encouragement.

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(¹) Raven, J. C. (1948), "A Method for Determining the Typicality of Personality Descriptions," *J. Ment. Sci.*, **94**, No. 394 (January).
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CASE OF "NAEVOID AMENTIA" WITH BILATERAL CEREBRAL LESIONS.

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[Received 4 December, 1949.]

WORSTER-DROUGHT (1948) recently published a case of bilateral Kalischer-Sturge-Weber syndrome and reviewed the literature on the subject. It would appear that cerebral haemangiomata are frequently multiple or extensive, though many accounts of the condition are not precise on this point, so that a bilateral lesion is probably common though not many have been diagnosed as such. Courville (1945) publishes an illustration of a case of multiple cerebral venous angiomata.

The following case presents some features of special interest.

History.—Born: 20.vi.44.

The parents were of normal intelligence. The father had a clerical post. The father and mother were aged 30 and 32, respectively, at the time of the patient's birth. There was considerable cerebral morbidity on the father's side of the family, as shown in the table.

The patient is the second of three children. The brother, 2 years older, was healthy, also the brother 4 years younger.

The birth appears to have been normal except that it was rather rapid. The mother also states that she was 6 months pregnant before she became aware of the fact!

The child was not noted to be abnormal at birth, apart from the port-wine stain on the right side of the forehead (see photograph). It was thought that she would be bright, as at 3 weeks she was making baby noises, etc. At 6 months she had bronchitis when cutting her first tooth. Her eyes then became fixed and she had a series of right-sided fits.

At 10 months the child was very ill and seemed to lose all control of her head and limbs. The mother thought the child had meningitis. She then had two fits, one lasting an hour, the other four hours. From then until admission to the Fountain Hospital there were only four more fits in January, 1947.

In October, 1944, she was seen at the Hospital For Sick Children on account of her facial naevus. Specific treatment was not advised. She again attended in July, 1945, on account of backwardness. Radiography of the skull showed no abnormality. Unsuccessful attempts were made to examine her eyes. Examination under anaesthetic was recommended.

The child was brought for admission on 5.ii.48, by the parents, in view of her continued lack of progress. A psychiatric report which accompanied her stated: "The history of right-sided fits, combined with the presence of port-wine stain on the right side of the head and a bruit heard over the left temporal region, suggest that the cause of this is an intracranial haemangioma." She was said to be restless, rushing about the room and snatching everything within reach. She was reported not to obey simple commands or imitate simple actions. She was said to make no attempt to build bricks, or play with toys, she could not speak, was wet and dirty, and was destructive. She was said to put her finger into the ink pot and everything into her mouth. She had to be fed. Her father was not certain that she always recognized him.

On admission.—No gross physical abnormality was found, apart from a large cutaneous, capillary naevus (see illustration) and a convergent squint affecting the left eye. The cranial murmur, previously reported, could not be heard. She was a lively child using her energy in a purposeless fashion. She was able to say a few words such as "Mama," "Ta-ta" and "girl." She was unable to use a spoon and had to be fed. She was doubly incontinent.

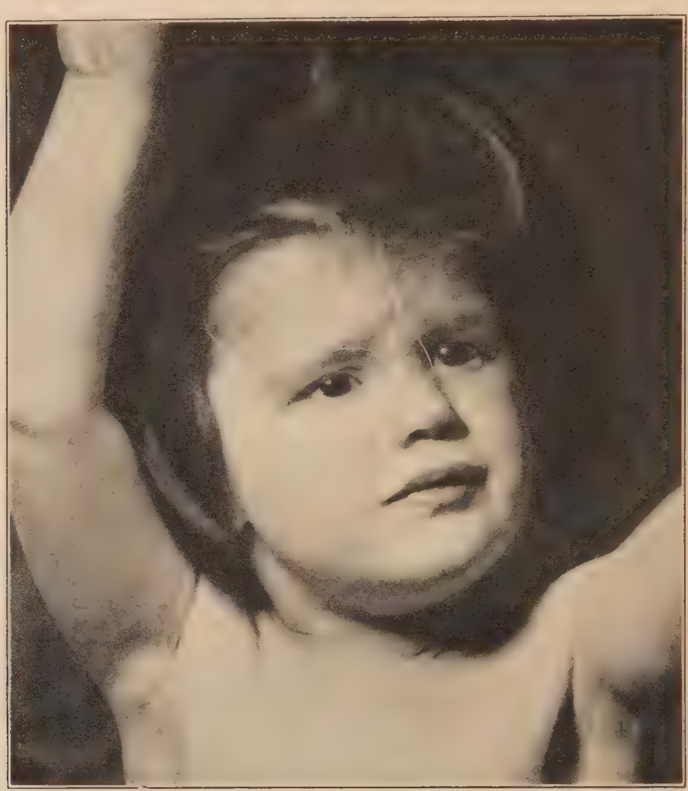

FIG. 1.—Photograph of patient showing facial naevus with distribution corresponding roughly to ophthalmic division of right trigeminal—on forehead and down on to bridge of nose, overlapping somewhat in the mid-line.

Investigations.

X-ray skull.—Report stated: "There is a group of coarse diploic channels in the right frontal with which some coarse diploic trunks connect. In the lower part of the area laterally there is an area of increased translucency, roughly circular, of about ½ in. diameter and vaguely outlined, with which several of the channels connect. I think that these findings indicate a haemangioma."

Electroencephalogram.—"Gross generalized slow-wave abnormalities in all areas. Maximal abnormality in (1) right frontal area (right frontal focus of high voltage 3 c./sec. activity) and (2) in the lower and posterior part of left hemisphere, where the slowest activity is seen. In this area slow spike-and-wave, and "sharp" waves are seen. The latter side would appear more epileptogenic than the right side."

Lumbar puncture.—Wassermann reaction negative. Cells: 1 per c.mm. Lange: Normal. Protein: 30 mgm. per 100 c.c.

Blood Wassermann reaction and parallel test.—Negative.

Angiography.—She was admitted to the National Hospital, Queen Square, for further examination on 15.ii.49. Unfortunately a percutaneous arteriogram proved impossible owing to the small size of the carotid artery. An X-ray of the skull, done at the same time, showed traces of cortical calcification in the occipital region.

Ophthalmoscopy.—No abnormality of fundi found.

Progress.—Shortly after admission she developed whooping cough, followed by measles and pneumonia. Following these illnesses she had a series of epileptic fits. The first attack affected the left side of the body only. The pupils were dilated and unequal, the left being greater than the right. In the next fit, 3 days later the right face and arm only were affected and twitching of these parts continued for 24 hours. Later a typical right-sided Jacksonian fit was seen. For a few days after this there was a residual, slight right hemiparesis with upgoing plantar response. Four distinct fits and two "successions" occurred in all during April and May, 1948, and again in October, 1948. There have been none since (March, 1949) the child regained normal physical health.

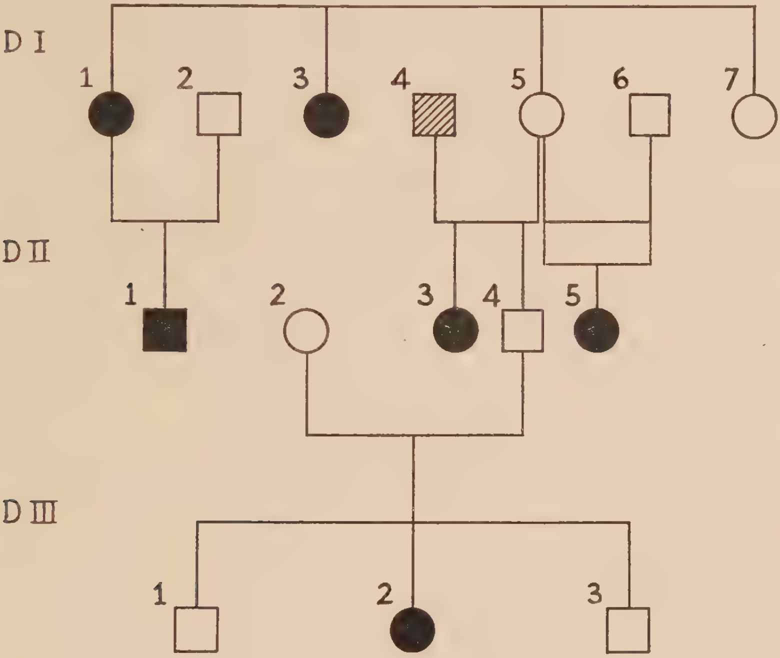

FIG. 2.—Genealogical table of patient. (See notes appended to text.)

There has been little change in her mental state. She lost such speech as she had, following her epileptic attacks, and has not regained this; also she is now definitely left-handed. She is still very active, but remains in need of every attention. She is still doubly incontinent and tends to smear her faeces about or to eat them if not prevented from doing so.

DISCUSSION.

The diagnosis of Kalischer-Sturge-Weber syndrome in this case is beyond doubt. There are, however, certain aspects which deserve further consideration.

The presence of a bruit in angiomatous malformations is thought to be limited (Cushing, 1928) to cases with arterial involvement. The use of the term Sturge-Weber syndrome is, however, restricted to purely venous lesions, and facial naevi are not associated with angioma arteriale (Brain, 1947). In this case the absence of a bruit has repeatedly been confirmed and the report of its existence prior to admission was probably due to an error.

Ford (1944) differs from other writers on the subject in listing the type of vascular malformation of the cerebral vessels associated with cutaneous naevi under "Telangiectases." He does, however, state that the difference between this type of lesion and the venous angioma is merely one of degree. Most authorities, however, prefer to classify the cerebral concomitant of the facial naevus as a venous angioma (Wilson, 1940) except in those rare cases of Lindau's syndrome where the cerebral symptoms are due to haemangioblastoma. Evidence in favour of hereditary factors is more abundant in the case of telangiectatic lesions than with the venous angiomata. Thus, Michael and Levin (1936) reported on a family in which five persons, in two generations, were affected.

The failure to obtain an angiogram in the present case is unfortunate, since any additional information which will elucidate the anatomy and pathology of these lesions will help to clear some of the confusion which still remains as to classification, an essential pre-requisite to a proper assessment of hereditary factors.

The prognosis in this case, as in all cases of mental deficiency, requires careful appraisal. As to expectation of life, Brushfield's case had reached the age of 67 (1929). The statement that "the outlook is hopeless" is not helpful to the parents, and may serve to discredit the physician if the child's potentialities prove greater than the interpretation of this statement led them to expect. In many such cases there is gross limitation and disturbance of cerebral function. In the present instance the intelligence quotient is roughly 40, though no reliance can be placed on this estimate at such an early age. The optimum prognosis, then, is that attaching to any high-grade imbecile with an epileptic tendency. There is, however, the added risk that the supervention of an intercurrent infection may cause a series of fits, possibly increasing the extent of irreparable cerebral damage.

Treatment, therefore, is conservative; training is required to make the best use of the child's limited potentialities, and care to avoid, as far as possible, the risk attendant on even mild infections. Radical treatment is not indicated. The extent, lack of precise delimitation, possible multiplicity and haemorrhagic properties of the lesion preclude surgical intervention (Rawling, 1929). Also, since the pathology is not that of a true neoplasm such as the haemangioblastoma of Lindau's syndrome the constituent cells of the lesion are not radiosensitive so that no benefit is to be anticipated from radiotherapy.

There is still a tendency, although without an adequate factual basis, to look upon mental deficiency as a disease *sui generis*. In some instances venous angiomata are not associated with gross mental deficiency, and are accidental post-mortem findings. For this reason Tredgold (1929) came to the conclusion that "amentia is not a necessary consequence of the naevus," considering that the "amentia" was "of a primary form" and that the naevus has merely an associated developmental abnormality. Brushfield and Wyatt (1928) lend substance to this view by stating that the brain of one of their cases showed "definite underdevelopment of the neurones." They are doubtful, however, whether the naevi should be looked upon as "stigmata of degeneration." In fact, however, it is easier to explain the degree of mental defect and disturbance in cases such as the present one, as due directly and specifically to the angiomatous malformation. Kalischer (1897) attributed the fits and paresis in his case to the effect of the angioma, though mentioning an associated asymmetry of the cerebral hemispheres. Weber (1929) and Brain (1948) refer to the Sturge-Weber syndrome as involving a naevus on the same side as the cerebral lesion but in fact the cerebral locus, in Brushfield's original case (Tredgold, 1929), was on the opposite side. The lesion in this case appears undoubtedly bilateral and is probably very extensive. Apart from the space occupied by the lesion, which may be considerable, there is the gross disturbance of cerebral function with at least two major epileptogenic areas as revealed by the electroencephalogram. There is also the possibility (Courville, 1945) of further damage to the brain from haemorrhage from the vessels of the lesion.

[Weber (1946) is inclined to the opposite point of view from Tredgold, and states that the condition is not due to a genetic cause but to an accidental local injury to the ovum. He is presumably not impressed either by the "neuropathic family history" or by the "stigmata of degeneration" (Brushfield, 1927), upon which so much stress was at one time laid.]

The use of the terms "primary" and "secondary" in relation to mental defect, as in some other fields of pathology, is no longer helpful, and should be abandoned in favour of an effort to define more precisely the relative importance and nature of the various genetic and environmental factors operating in each case, as well as the mechanism through which these factors operate.

SUMMARY.

A case of mental deficiency in a girl aged 5, due to a bilateral Kalischer-Sturge-Weber syndrome, is described. The evidence in favour of a recessive, hereditary factor is presented. The effect on the prognosis of external factors, e.g. infection, is discussed. Apart from this the prognosis is considered to be that of other mental defectives of similar grade. The mental deficiency is attributed directly to the lesion. The need for replacement of the terms primary and secondary mental defect by a more dynamic and balanced approach to the classification of mental defect is considered.

There is no definite evidence of naevus in any member of the family other than the patient. A number of members, however, showed fits, paralysis or other neurological lesions, as follows:

> D.I. 1. The grandmother's elder sister. She was born with a degree of paralysis which was not so severe as to prevent her from marrying and having a child, but which has become worse so that she is now almost completely paraplegic.
>
> D.II. 1. The son of the above, died at 3 months in convulsions.
>
> D.I. 3. The second sister in the grandmother's sibship, always a little unusual, became definitely psychotic in middle life and died in a mental hospital.
>
> D.I. 5. The patient's paternal grandmother was always looked upon as abnormal, as was her younger sister, D.I. 7.

D.I. 4. The grandmother's first husband and the patient's grandfather had a doubtful history of epilepsy in early childhood, but has had no fits since early life.

D.II. 5. The child of the second marriage was born with a "withered arm," and apparently has a hemiparesis.

D.II. 3. The elder sister of the patient died at the age of 3 months in convulsions.

D.II. 4. The father appears introverted and a little neurotic.

My thanks are due to Dr. Denis Hill for the report on the electroencephalogram and to Dr. E. M. White for the report on the X-ray films of the head.

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CATARACTS, ATAXIA AND MENTAL DEFICIENCY: A REPORT OF TWO CASES.

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[Received 27 November, 1949.]

This combination of symptoms was reported in a Roumanian article (1927) as having occurred in four siblings. Its occurrence was also noted by Sjögren (1935) in four families. In two of the families the parents were consanguineous and in one of these there were two children only, both with the full syndrome, while in the other there were eight children, three normal, one with the full syndrome and three who died in the first year of life. In one of the other two families (no parental consanguinity) an only child was affected and in the other, one was affected and four were normal.

In all five of Sjögren's cases the condition appears to segregate as a whole, members of the family either displaying all three features or else being normal in these respects. Marinesco, Dragonesco and Vassiliu reported, in addition to the above findings, an unusually low concentration of blood serum calcium. The mother, however, who appeared to be normal in every other way, also had an unusually low blood calcium and so did one of the normal siblings, so this finding may not have been significant.

The four Roumanian siblings manifested brisk or exaggerated tendon reflexes, hypotonia with hyperextensibility of joints and some diminution of muscular power. They also showed cataracts, low stature and mental deficiency of moderate degree. The neurological signs in Sjögren's cases were not described in detail, as these particular cases were not under investigation at the time.

Only two patients with cataracts, ataxia and mental deficiency have been seen by the author in a population of rather more than two thousand mental defectives of all grades and ages. They bear a number of similarities which may be significant.

Case 1.—Female, aged 11 years 6 months. Illegitimate; very little family history available. There is one sibling, five years older, believed to be normal.

Past history.—Prenatal and birth conditions normal. Mental deficiency noticed when the patient was 8 months old. Sat up at the age of 2 years.

On admission in 1941: Weight 1 st. 8 lb. Height 2 ft. 4 in. Protuberant abdomen. Limbs flaccid. Unable to stand without support. Nervous system: No wasting and muscular power quite good: left internal strabismus. Other cranial nerves normal. Abdominal reflexes brisk and equal. No tendon jerks obtained. Extensor plantar responses. Mental condition: able to feed herself. Plays with toys and with other children. Clean in habits. Unable to dress and undress without assistance. Able to speak a few phrases. I.Q. 68 (Terman-Merrill). In 1943 the ophthalmologist reported "Small opacity in centre of lens, right and left." This had not been noted at the previous routine physical examination and was presumably not present on admission. The cataracts have since progressed steadily and in August, 1948, the right cataract, the more advanced one, was needled. The present neurological condition is as follows: Gait staggering and balance not maintained without support. Movements of the trunk are not co-ordinated with those of the limbs, so that she falls backwards or sideways. Speech normal. No involuntary movements at rest. Slight intention tremor on the finger-nose test. No wasting. Muscular power good. Biceps and supinator jerks present, but diminished. Triceps jerk absent. Knee and ankle jerks occasionally elicitable. Plantar reflexes sometimes extensor. Abdominal reflexes present and equal. All sensations normal. Bilateral pes planovalgus. W.R. and Kahn test negative. Serum calcium 10·6 mgm. per ml.

Case 2.—Male, born in 1902 and admitted at the age of 35. Mother aged 34 years at his birth. No parental consanguinity. Normal pregnancy and labour. Patient is the third of five siblings, the eldest of whom, a female, has congenital dislocation of the hip. The patient had a twin of the same sex who died at the age of seven months from bronchopneumonia following measles. It cannot be ascertained whether or not the twins were identical.

Past history.—Prenatal and birth conditions normal. Backward in learning to walk and talk and in taking solid food. Believed to have been about two years of age before he could walk or talk. Learnt to read quite well at school, but it is not known if he was backward at school or not. It was noticed before school age that the patient was not walking properly (at about 5 years ?) and from then onward the gait has steadily deteriorated. It was noticed at 10–11 years that the right eye "started to turn towards the corner" and vision became impaired.

The present condition is as follows: The patient is able to feed himself and speech is quite normal. He is almost completely blind, He can distinguish the light. His estimated mental age is 10 years. His height is 5 ft. 3 in. He suffers from bilateral cataracts and choroiditis. The cataracts are total and uniform, but not of great density. They are hazy, not pearly white in appearance. Central nervous system: Right internal strabismus. No other cranial nerve palsies. No muscular wasting. Generally good muscular power. Muscle tone definitely diminished. The abdomen is protuberant, the feet are in the position of pes planovalgus. Both these findings are presumably due to low muscle tone. Abdominal reflexes are present, but all tendon reflexes of arms and legs are consistently absent. The plantar reflexes are extensor. There are no involuntary movements, but there is slight intention tremor on the finger-nose test. The gait is staggering and the patient cannot walk without support. He is able to stand, but sways more than usual on doing so. All sensations, including position sense, are normal.

W.R. and Kahn tests are negative. Serum calcium 9·5 mgm. per ml.

These two patients show a considerable degree of similarity in their abnormal features:

1. Mental deficiency of mild to moderate degree.
2. Cataracts, not congenital, but appearing in the first decade of life and progressing.
3. Ataxia appearing in early life. In one case progressive.
4. Hypotonia, diminished or absent tendon reflexes and extensor plantar responses.
5. Strabismus.

The absence of speech defect in spite of the presence of advanced ataxia of cerebellar type is a peculiarity of these cases. Such a finding is unusual in Friedreich's ataxia. Sjögren found some degree of mental deficiency in 15 per cent. of patients with that condition (1943), but Davies (1949), in a psychometric study of a small series, did not find the intelligence level to differ appreciably from that of the general population. Cataracts are also no commoner in the known hereditary ataxias than in the general population. The characteristic skeletal deformities of Friedreich's ataxia are absent in these cases.

Summary and Conclusions.

Two patients with cataracts, ataxia and mental deficiency have been described. The cataracts were progressive in both cases and probably not present at birth. Ataxia was severe and of cerebellar type, but speech function was not impaired. Mental deficiency was of mild degree. The uniformity of the findings makes it probable that the condition is a disease entity which may include other cases described in the literature and characterized by the same three cardinal findings. The underlying pathology is evidently widespread within the nervous system. The eye, the cerebellum or cerebellar tracts and some part of the pyramidal pathways must be implicated, in addition to those parts of the cortex upon the integrity and proper maturation of which normal intellectual capacity is dependent. Loss of tendon reflexes implies posterior column involvement.

My thanks are due to Dr. Taylar and Dr. Burke for permission to report these cases, and to Dr. Millman who kindly supplied me with the notes of Case 1.

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NOMOGRAM FOR THE REES-EYSENCK BODY INDEX.

By Max Hamilton,

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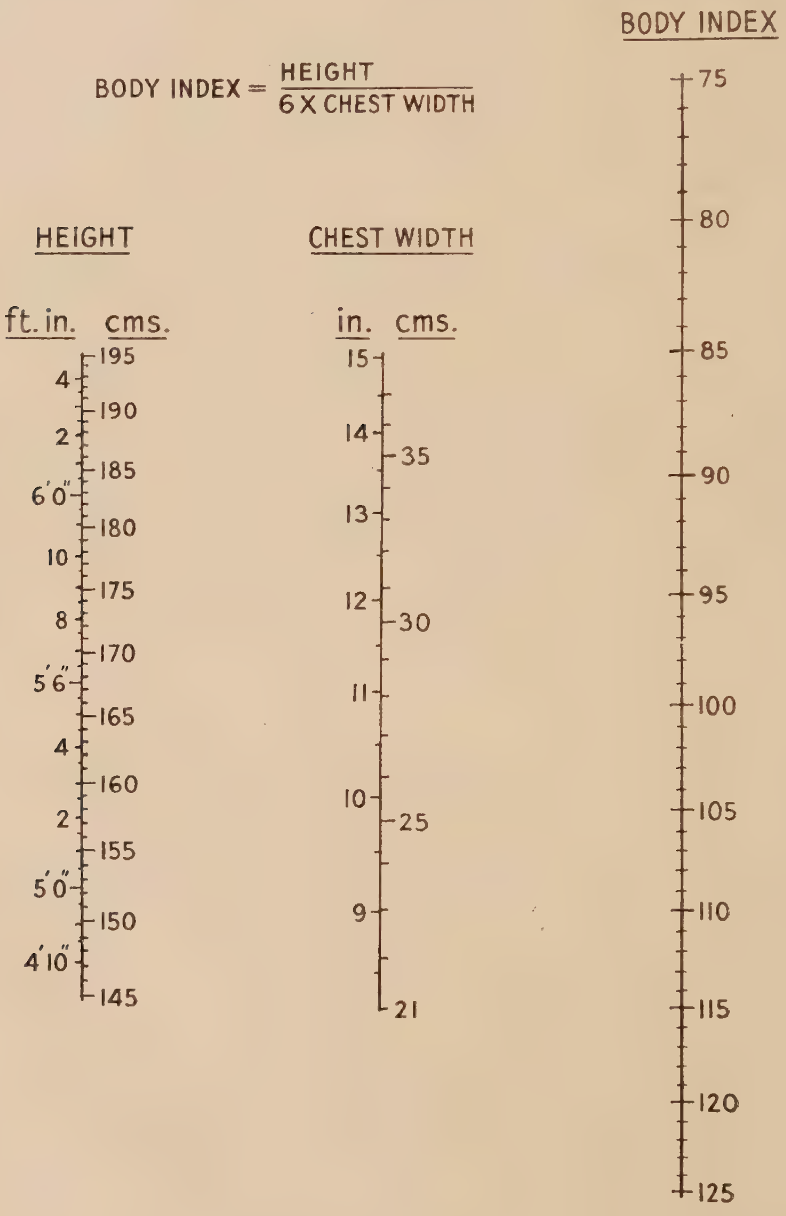
Instructions for Use.

The Body Index is obtained by joining the height and chest width with a straight line and continuing it to the Body Index scale. This can be done by stretching a black thread across the Nomogram, or by using the edge of a ruler. The neatest way is to use a black line on a transparent ruler.



$$\text{BODY INDEX} = \frac{\text{HEIGHT}}{6 \times \text{CHEST WIDTH}}$$

BODY INDEX
75
80
85
90
95
100
105
110
115
120
125
HEIGHT
ft. in.
cms.
195
4
190
2
185
6′ 0″
180
10
175
8
170
5′ 6″
165
4
160
2
155
5′ 0″
150
4′ 10″
145
CHEST WIDTH
in.
cms.
15
14
35
13
12
30
11
10
25
9
21

Part II.—Reviews.

The Driving Forces of Human Nature. By DOM THOMAS VERNER MOORE, O.S.B. Ph.D. M.D. London: W. Heinemann (Medical Books), 1948. Pp. 461. Price 35*s*.

This erudite volume is an introduction to the Catholic approach to the psychology and psychopathology of emotional behaviour and volitional control. The distinguished author deals with his subject from the point of view of psychiatry, psychology and religion, each supplementing the other. He introduces in some detail several interesting case studies—many dating from World War I—to illustrate some methods of treating psychiatrically certain disorders of the mind. He believes that although psychotherapy involves the readjustment of the maladjusted personality, full and adequate adjustment of the human mind involves a relationship to God as well as to society, and he sets out to outline this adjustment in its ideal perfection.

A preliminary historical introduction to psychology is followed by discussions on consciousness and the unconscious, the human emotional life, the psychopathology of emotional life, the driving forces of human nature and their adjustment, the will and voluntary action, and the problems of voluntary adjustment. Freud's teachings on conflict, repression and regression are considered, but Father Moore emphasizes the point that no explanation has ever been given of the psychological nature of Freud's eternally vigilant censor. He is also unable to accept Freud's extreme views on the universal sexuality of deeply unconscious motivation. The section on volition is argued from the Catholic point of view. Although it may not be entirely acceptable to the non-Catholic reader it is stimulating as well as provocative. The book is one to read. Certain sections will be re-read with profit. W. NORWOOD EAST.

Encyclopedia of Criminology. Edited by VERNON C. BRANHAM, M.D., and SAMUEL B. KUTASH, Ph.D. Philosophical Library, New York: 1949. Pp. xxxvii + 527. Price $12.00.

This comprehensive work of nearly half a million words is the result of the combined efforts of sixty-one American specialists in criminological research, education, history, law, medicine, penology, philosophy, police science, psychiatry, psychology, religion and sociology. The editors state that every effort was made to cover all basic concepts and theories that have contributed to the development of criminology as a science. At the same time they recognize that the book cannot be a substitute for original sources of knowledge, since most of the topics covered could justify a volume to themselves. This has been met as far as possible by the provision of a bibliography to each article, suggesting further reading in the particular subject. The references are mainly to American writers, but the articles will interest those elsewhere who are concerned with crime and criminals.

The book is a mine of valuable information, probably not obtainable elsewhere within a single cover. The editors appear justified in their claim that no significant approach has been neglected. They, together with the distinguished writers of the articles, are to be sincerely congratulated upon the successful result of their formidable task. W. NORWOOD EAST.

Social Biology and Welfare. By SYBIL NEVILLE-ROLFE. London: Geo. Allen & Unwin, 1949. Pp. 416. Price 21*s.*

The writer, who is perhaps best known as formerly the Honorary Secretary and Secretary-General, British Social Hygiene Council, 1914–1944, emphasizes in this book the importance of the biological approach to the individual in his social setting and of estimating the effect of our social structure upon the individual and the family.

The book is provocative and the informed reader will usually have no difficulty in agreeing with or opposing the writer's point of view. A brief discussion on social biology is followed by sections on values, the individual, age cycle and behaviour pattern, sex behaviour, family relationships, prostitution, venereal disease (by Dr. A. E. W. McLachlan), health and behaviour, social work in the Colonial Empire, and current problems of social hygiene. A " Handbook-Appendix " on social problems edited by Ethel Grant concludes the text.

The general reader will perhaps find the various sections of equal interest. That dealing with prostitution presents a particularly useful summary of the present position, and is a subject to which Mrs. Neville-Rolfe has devoted much time and study. Among matters discussed in the section on current problems of social hygiene is artificial insemination and the three processes used in this connection to combat marital infertility are sufficiently described. It is stated that the successes attending the technique are high. In the U.S.A., where it is said to be used more frequently than here, 5,000 successes are claimed as compared with 300 cases in Great Britain. The number of failures is not given, and it is to be assumed from the text that pregnancy is the standard of success. The sociologist, however, will surely require the future happiness and social usefulness of the child as well as of the mother and her husband to be the essential requirements. It is stated that there seems no possible reason for others to call on the law to intervene in any case. But the legal aspects of artificial insemination are barely touched upon. Some readers also may consider that the religious factors involved might have been discussed at greater length.

The book is easy to read, but occasionally the inquirer will wish to know the foundation upon which a statement is based. The dogmatic assertion that " the only child becomes the problem child " may lead the neophyte away from the fact that the problem child also appears in larger families. A recent investigation showed that of 4,000 adolescent offenders, 8·5 per cent. were only children; the remainder had one or more brothers and sisters. However, this may be, the reader will welcome the sincere enthusiasm which is expressed constantly throughout this book, and which inspired the writer to carry out her self-imposed task throughout so many years. W. NORWOOD EAST.

Diseases of the Nervous System. By F. M. R. WALSHE, M.D., D.Sc., F.R.S. Sixth Edition. Edinburgh: E. & S. Livingstone, 1949. Price 17*s.* 6*d.*

This excellent text-book of neurology has reached its sixth edition, and the author is to be congratulated on six editions in nine years.

The chapter on neurosyphilis has been re-written and the author gives special attention to penicillin. The true effect of penicillin has yet to be assessed accurately. Smith and Morais have shown the effect of penicillin on the pathological process in general paralysis. They say that penicillin alone is capable of much the same effect as malaria.

We do not agree that leucotomy has no place in the treatment of the psychoneuroses. It has a place and an important one in those chronic neuroses which will not yield to psychological treatment. In the same way one has seen an hysterical aphonia and an hysterical paralysis which had been resistant to psychotherapy cured very quickly by E.C.T. G. W. T. H. FLEMING.

Personnel Selection in the British Forces. By PHILIP E. VERNON and JOHN B. PARRY. London: University of London Press, 1949. Pp. 324. Price 20s.

From the preface: "During the second World War scientific methods of personnel selection were applied in the Royal Navy, the Army and A.T.S., and the Royal Air Force on a scale quite unprecedented in Britain. This development has naturally aroused widespread interest and a desire for further information beyond that provided by articles in the popular press or in technical psychological journals. The present book attempts, therefore, to give an account of the procedures used and the results obtained. It is addressed both to the industrialist or educationist who hopes that the methods may be of value in the peace-time selection of employees, students or pupils, and to the student of psychology or to the personnel officer who wishes to know what psychological discoveries were made and what techniques were found most valuable. If for this reason it falls between two stools, we must apologise; it is not easy to write a simple, readable and interesting description for the former and at the same time to give the latter all the technical details that he needs. Statistical terms, formulae and calculations have been kept to the barest minimum and will, it is hoped, be published elsewhere.

"Our primary aim has been to describe such novel contributions as were made in the Fighting Services. But although space has not allowed a comprehensive survey of peace-time selection and guidance, we have tried to view our methods and results in this broader setting, and to integrate them with recent developments in civilian vocational and educational psychology.

"After an historical introduction, Part I is concerned with the organization of selection, the general procedures employed, and the work of psychologists in the Royal Navy, Army and A.T.S., and the R.A.F. Part II takes up the principles of selection and guidance which have evolved both from pre-war investigations and from war-time experience. It reviews the technique of interviewing and testing, together with evidence of their merits and defects, in some detail. Each chapter is preceded by a general summary or abstract, and the main conclusions relevant to peace-time work are brought together in the final chapter."

I found the book interesting and informative, and so, I think, will most psychiatrists. I cannot decide whether, in fact, the authors' fears of its falling between two stools are justified. The risk should not have been taken. Good as this book is, separate books for the different classes of readers would have been better. The material is rich enough and important enough to warrant them. M. B. BRODY (see p. 551).

The Clinical Application of Psychological Tests. By ROY SCHAFER. New York: Menninger Foundation Monograph Series, No. 6. International Universities Press, Inc., 1948. Pp. 346. Price $6.75.

The main purpose of this book is to show how a battery of tests may be used for the better diagnosis and fuller understanding of individual patients. The battery comprises the Wechsler Bellevue Scale, a Word Association Test, the Rorschach Test, an Object Sorting Test, the Thematic Apperception Test, and a Learning Efficiency Test based on immediate and delayed recall of a paragraph.

After a brief introduction and a few general considerations, Schafer devotes 70-odd pages to "diagnostic summaries." These set out those features in the performance of each test and of the battery as a whole, which characterize patients suffering from a variety of psychiatric syndromes. All but about

20 pages of the rest of the book is occupied by case studies. Each case study includes a verbatim record of the subject's responses, a full analyses of these, a test report, a diagnostic impression, and a clinical summary.

This book is a sequel to *Diagnostic Psychological Testing.* It begins promisingly enough by indicating firmly though discreetly where experience has shown its progenitor to be at fault both in practical details and in method of approach. The main sections of the book, however, disappointed me. Hitherto, there has been more conflict of opinion than agreement about the constitution—even the existence—of different mental test characteristics in different psychiatric conditions, and Schafer advances no evidence that his formulations are any more reliable than those that have previously appeared and have been disputed. He relates " the various (psychometric) indications to specific identifying characteristics of each syndrome and not to the name of the syndrome," but fails thereby to sharpen differential diagnosis, which, he admits, is often difficult. Qualifying terms, such as " sometimes," " generally," " usually," " a fair number of cases," etc., recur disconcertingly often. The absence from the patient population of manics, catatonic and hebephrenic schizophrenics, mental defectives, and patients with organic brain disease surely casts on the arguments more than the shadow of doubt which is reluctantly conceded in a footnote.

The chief interest in the case studies lies in the elaborate and meticulous exposition of each step in the process of interpreting the test responses. Schafer makes it all seem deceptively simple, like an illusionist explaining his tricks. He hopes that such expositions will help to reclaim mental test interpretation from the " domain of private insights and art." It is a pity that the Rorschach and Thematic Apperception Tests appear so prominently in his work, for many psychologists believe that it is precisely that type of test which dooms this hope to inevitable failure.
M. B. Brody.

Les Tests Mentaux En Psychiatrie. Tome 1re. Instruments et Méthodes. Par Pierre Pichot. Bibliothèque de Psychiatric. Presses Universitaires de France, 1949. Pp. xv + 238. Price 500 francs.

This, the first of two volumes, describes and critically examines mental test techniques. It will be followed by a volume on the results of their application in psychiatric conditions. Dr. Pichot begins with quantitative tests of ability, distinguishing three types according to their method of validation. The first type, validated empirically, includes most of the well known tests and scales for children and adolescents, pre-school children, and adults. The second type, based on *a priori* analyses of intelligence, includes, for example, tests of " attention," " memory," and the C.A.V.D. The third type, based on factorial analyses, includes tests for " g," " v," etc. In each type there may, and usually are, verbal performance, paper and pencil, individual and group tests. Dr. Pichot next examines the qualitative tests of ability, the tests of concept formation. The first part of the book ends with a chapter on inter-test relations, including scatter, deterioration tests, and test profiles. Part II is devoted to techniques for the assessment of personality. These are divided into two types, the analytic, and the syncretic or the projective, the former being techniques for investigating specific aspects of the personality, the latter for investigating the personality as a whole. In addition to describing and discussing the tests, the author supplies a most useful list of the publications giving, for each test, the full administrative and scoring details, and also a list of the distributors of the tests in France, Great Britain, Holland, Switzerland and the U.S.A.

This is not the first book designed for the increasing number of psychiatrists and psychologists who are using mental tests in psychiatry, but it is much the best. It is remarkably up-to-date and complete , and, in welcome contrast to the many American publications whose authors seem unaware of anything published outside their own country, it does full justice to the European literature. For this reason alone it is well worth while. The techniques are described clearly, accurately, and with a knowledge of their history which, surely, testifies not only to Dr. Pichot's erudition, but also to his facility for languages. The great feature of the book, however, lies in the discussions of the tests. Here Dr. Pichot will satisfy the psychologist, by his command of standardisation, factorial analysis, internal and external criteria and other such mysteries, and, equally, the psychiatrist, by his constant orientation towards the needs of practical everyday clinical psychiatry.

This book will be for the expert mental tester, a handy reference book; for the clinican, a clear and critical exposition of a growing discipline; and for both sides involved in the D.P.M. scramble, a key to those examination questions about mental tests for which, one suspects, the examiners are as much in need of a reliable authority as the candidates. One looks forward to the completion by the second volume of a work which one confidently expects to be standard for some years.

M. B. Brody.

The Trend of Scottish Intelligence. Publications of the Scottish Council for Research in Education, xxx. London University Press, 1949. Pp. xxviii + 151. Price 7*s.* 6*d.*

In 1932 the Scottish Council for Research in Education administered a group test of intelligence to all 11-year-old Scottish school children, totalling almost 90,000, of whom 1,000 were further tested individually with the 1916 Stanford Binet test. At the instigation of the Population Investigation Committee the experiment was repeated in 1945 on all the children then aged 11, using the same group test, but substituting the Terman Merrill for the Stanford ford Binet to 1,215 of these children tested individually. Certain sociological facts about the children were also collected. This report is the first of what should be a most valuable series based on the enormous amount of data. It shows beyond possibility of dispute that on the average, members of large families are less intelligent than members of small families. Nevertheless, the average score on the group test of the total group showed an increase from 34·5 in 1932 to 36·7 points in 1945. After statistical adjustments had been made in order to make the Terman-Merrill and Stanford Binet I.Q.'s strictly comparable, neither increase nor decrease could be proven. On the group test, girls have improved more than boys, but the reverse is true as regards the Terman-Merrill. These are but a few of the many important results given and discussed in this report of a research which in its careful preparation, meticulous execution, pellucid exposition and scientific reasoning, is a model work. Although eight of the nine chapters are written by different members of the Survey Committee, of which Sir Geoffrey Thompson was Chairman, the style is remarkably even. Psychologists, psychiatrists, educationalists, geneticists and sociologists will all read this book with profit and pleasure.

M. B. Brody.

Acute Injuries of the Head. By G. F. Rowbotham, F.R.C.S. Third Edition. Edinburgh: E. & S. Livingstone, 1949. Pp. 480. Price 35*s.*

This handsome volume continues to grow more handsome than ever. It is a masterly production on acute injuries of the head, beautifully—even lavishly—illustrated; there are nearly as many illustrations as pages.

Amongst other chapters that have been expanded, that on open or compound wounds of the head has been well done and we are given an account of the use of penicillin. The author emphasizes the danger of underdosage; perhaps this unconsciously leads the author to miss an obvious error at the foot of p. 304, where he says that "12,000 *c.c.*'s of penicillin twice daily are sufficient to keep up an adequate continuous level in the cerebrospinal fluid!" 12,000 *units* is obviously meant.

Nearly sixty new illustrations—some of them in colour—are added. The reproduction of all the illustrations in the book is extremely good.

G. W. T. H. Fleming.

The Third Mental Measurements Yearbook. Edited by O. K. Buros. New Brunswick: Rutgers University Press, 1949. Pp. 1,246.

It is difficult to review a reference tome of this size; the fact remains that, like its predecessors, it is extremely well done and covers a vast field. The measurements include tests of English, Italian, French and other languages, tests in mathematics, in agriculture, business education, health, home economics, reading, social studies, vocations and a variety of other subjects. There is an extensive bibliography to each section in which the titles of the paper are included. This, although it means more paper, is a great help to scientific workers, who are so often accustomed to the bare "name and page" variety.

G. W. T. H. Fleming.

Psychobiology and Psychiatry. By W. Muncie, M.D. Second Edition. London: Henry Kimpton, 1948. Pp. 620. Price 45*s*.

The first edition of this book appeared before World War II and now we have the second edition three years after the end of the war. The author is a stalwart supporter of the great Adolf Meyer, who did so much for psychiatry not only in the United States, but in the world of psychiatry as a whole.

Psychobiology, as Muncie sees it, is a long-section study of the personality seen through the eyes of reaction to environment. There are many long case-histories showing with what great detail all cases have been examined, in fact they occupy a large proportion of the space in a six-hundred-page volume.

While one does not expect a psychobiologist to look with a very favourable eye on leucotomy (and the author is careful to point out in his preface the shortsightedness of condemning it!), we think the writer might have devoted more than a page and a half to it. His statements on p. 549 that "A scalpel is introduced through a burr opening in the skull at the base of the frontal lobe, and in a wide sweep cuts the thalamofrontal radiation as well as other tracts, probably callosal and the fasciculus cinguli," and on the following page, "Since it is ordinarily performed under local anaesthesia, the operator may talk with and observe the patient throughout," make the reviewer's hair stand on end. It is certainly not the way leucotomy has ever been done in this country. He does mention rather casually the more recent developments, which sound like the various "undercutting" techniques, but gives no references to guide the reader.

There is, however, in the book as a whole, a lot of useful clinical information and no doubt many psychiatrists would benefit by devoting to it the many hours required to read it.

G. W. T. H. Fleming.

Fatigue and Impairment in Man. By S. H. Bartley, Ph.D., and E. Chate, M.A. London and New York: McGraw-Hill Publishing Co., 1947. Pp. 429. Price $5.50.

This is an excellent account of the many problems arising out of fatigue in man. It is a study in applied physiology and as such is objective in its approach to the mine of information scattered through a multitude of journals. Some of the chapters stand out above the others; the chapter on "sleep and other periodicities" is particularly well done, as is that on "mental fatigue." The work of Edwards on the effects of the loss of one hundred hours of sleep is most interesting, the subjects reporting absence of fatigue for a considerable time during the first part of the 100 hours' vigil. Having done a 72-hour vigil the writer can testify to the absence of fatigue for a long time, but towards the end the difficulty in keeping awake whilst dealing with patients in the 1918 "Flue" epidemic was immense: in the end sleep won, fortunately before the advent of any "delusional statements" or "inability to differentiate between hot and cold water"! Kleitman is known to have kept awake for 120 hours without benzedrine and for 192 hours with!

There is a great deal in this book which is of value to the psychiatrist.

G W. T. H. FLEMING.

The Energetics of Human Behavior. By G. L. FREEMAN. Ph.D. New York: Cornell University Press, 1948. Pp. 344. $3.50.

The author develops " . . . the basic thesis that all behavior is an attempt to preserve organismic integrity by homeostatic restorations of equilibrium." Having stated his thesis in the first four chapters, the author applies it, in five succeeding chapters, to "Motivation; Learning; Discriminatory behavior; Personality differentiation; and Behavior disorder and therapy."

He treats the organism as a dynamic system by applying to it the basic physical principles of energy and equilibrium. These lead to Cannon's concept of homeostasis, and thus to the primitive self-regulatory mechanisms. He then shows why the concept of homeostasis cannot be restricted to systems working wholly within the body; for an unbroken series extends from those systems which work wholly within the body to those which make extensive use of the environment. The latter are important, for their behaviour has hitherto been described as "instinctive." In this way the instincts can be related to the homeostatic mechanisms, and through them to mechanisms of ordinary physical type. So the instincts, instead of being forces of mysterious psychological origin, become simply forms of those basic physico-chemical forces which drive all material systems.

His account of this extension is welcome, for although many workers have recognized in articles that the extension must be made, the author's statement is the first to appear in book form. Those who would like a simple description of this view of the instincts, written from the point of view of physiology and psychology, will find the book readable.

But from the point of view of physics the book is naïve and inaccurate. Though the word "energy" appears on every page, it is used with a looseness that would be allowed to no schoolboy. "Energy," a quantity, is nowhere distinguished from "power," its time-derivative. Nowhere is any distinction made between total energy, which is constant, and free energy, which diminishes, though this distinction is fundamental. The reader soon realizes that the word "energy" is in fact being used to describe not only energy, measured in ergs, but any sort of effort, or activity; or even a mere tendency to change. A word like "energy," one of the most precisely defined in all physics, should not be so degraded.

The author's difficulty has clearly been that, trying to discuss complex physical systems while unaware of the distinction now made between energy and information, he has tried to apply the older concept when the newer should have been used. The result is a confusion which the spreading knowledge of cybernetics should have dispelled. W. ROSS ASHBY.

Études Psychiatriques. By HENRI EY. Tome I: Bibliothèque Neuro-Psychiatrique de Langue Française. Paris: Desclée de Brouwer & Cie, 1948. Pp. 261.

When this work of Dr. Ey is complete it will comprise four volumes. The first, issued last year, deals with historical, methodological and general psychopathological themes.

The book, written with the lucidity and preciseness the French language provides, is full of wisdom and learning, and and expresses a truly holistic approach to psychiatry. It is "eclectic" in the sense of a positive, creative eclecticism and the author's personal view reveals itself clearly as he progresses in his survey of others. It is not a text-book, but a collection of essays in which one expects a varying level of depth and originality.

The first essay on "Madness and Human Values," the second on "The Mechanistic-dynamic Rhythm in the History of Medicine," the third on "The Mechanistic Development of Psychiatry," the fourth on "The Position of Psychiatry within the Framework of Medical Science" are historical and philosophical studies that show the author's power to formulate anew much-discussed problems. The fifth essay on de Clérambault, that in Anglo-Saxon psychiatry relatively little known "mechanist," is designed to demonstrate by a special example how the transition from mechanistic theory to dynamism necessarily has to take place, unbeknown and almost in spite of the man himself, and how his work, in fact, contained the germ of an integrated theory of psychiatry.

The sixth essay describes the school of psychoanalysis as an example of a psychogenetic theory. It is to be regretted that the distinctions between the offshoots of psychoanalysis have not been worked out sufficiently. For example, the finalistic and dialectic trend in Jung's work, the role of the unconscious as creative and compensatory, etc., have not been evaluated.

The seventh essay on the "Principles of an Organodynamic Conception of Psychiatry" is the synthesis in the author's mind of an integrated building of psychiatry to which the preceding essays furnished the building material. It shows fully the author's breadth of vision. He expounds the principles in the eighth and longest essay –comprising 90 pages on "the dream, a basic fact ('fait primordial') of psychopathology." It is a comparative study of the natural history of the dream phenomena and their significance in normal and abnormal mental life. The dream is for Ey the fundamental pattern of abnormal mechanisms, not only the royal way to the patient's personality in the sense of Freud, but the paradigm of all mental symptoms seen in psychiatric illness.

Whatever the orientation of a psychiatrist, he will derive great stimulation from this volume and look forward to what is to follow. It is the work of a systematic thinker and clinician of broad experience to which a short review like this cannot do justice. It has to be read and studied.

D. J. SALFIELD.

Projective Techniques. By JOHN ELDERKIN BELL. Longmans, 1948.

Projective Techniques, by John Elderkin Bell, of Clark University, is a formidable compendium of those types of test which are concerned with the assessment of the whole personality, as opposed to those techniques designed to assess a single trait or cluster of traits.

The term "projective" is taken to include tests which have been labelled "apperceptive" by others. The author seems to regard these terms as synonymous, although Shakow, among others, has pointed out that, strictly speaking, the word "projective" is more restricted in meaning than "apperceptive," and that it is the latter term which should be applied to this type of test. The author reminds us that the term "projection" derives from Freud, and that it relates to an unconscious defence mechanism. This makes it quite an unsuitable term for the description of the type of test under discussion. However, the author is careful to use the adjectival form of the word in the title of his book, while admitting its unsatisfactory nature.

The book covers Word Association tests, the Rorschach, T.A.T., Rosenzweig Picture Frustration and Szondi tests; Expressive Movement tests and

Play and Drama test situations. At the end of each chapter there are bibliographies, some of which seem more comprehensive than discriminating. Indeed, the one that covers the Rorschach test contains no less than 798 references. The tests have been rather arbitrarily grouped, but it is difficult to suggest a classification which would have been any more satisfactory. A brief history of each test is followed by details of its administration and interpretation. Modifications made by various workers are mentioned in some detail. Thus we learn that in the administration of the Rorschach test, whereas Beck asked his subject to return each card to him when he had finished, Klopfer asked him to turn it face downward on the table.

The chief value of the book lies, however in its description and bibliography of the lesser known tests. Those that are more familiar, like the Rorschach or T.A.T., have already been minutely described and discussed in the literature, although clinicians may well find it useful to have both these tests included with others in a single volume. Many new avenues of approach are indicated by the less familiar tests here described, and developments of these techniques will readily suggest themselves. The author expresses the hope that such developments will be one of the fruits of his labours.

The last chapter consists of a survey of the whole field. The author points out that the useful test tends to be self-perpetuating, and that its continued application builds up data to expand its benefits. This has an inhibiting effect on the use made of new tests which might otherwise prove to be even more informative. He then raises a fundamental issue which has too often been overlooked. This is the degree to which the psychologist's own attitudes influence the results of the test. He points out that the calibration of the examiner should become an essential part of the procedure, but adds that the means of doing so have not yet been developed. His reminder that too little work has been done on the assessment of reliability and validity of many projective techniques is timely, and should be heeded.

This volume should prove of value as a comprehensive reference book for all types of personality tests relying on projective (or apperceptive) techniques, and will certainly provide some stimulating ideas to those who have an interest in developing new lines of enquiry in this field. RALPH HETHERINGTON.

The Thematic Apperception Test. An Introductory Manual for its Clinical Use with Adult Males. By MORRIS I. STEIN. Addison-Wesley Press, 1948.

Morris Stein's introductory manual for the Thematic Apperception test is rather disappointing since its data are confined to adult males. The author hopes, however, to publish another handbook later covering all the variety of cases encountered in clinical research and practice.

He points out that whereas the Rorschach test provides information about the structure of the personality, the T.A.T. can be used to yield its content. The author hopes that this manual will help to break down the wall of secrecy that has surrounded the T.A.T. as a result of the special terminology originally used by Murray.

As well as analysing the intra-individual material, the author suggests that comparisions between individuals might be of value with the caveat that the former type of comparison has the greater value. He provides a " common story " for each of the 20 pictures for men. These stories are " based on clinical experience " and it would be of great interest to learn the method used to arrive at these common stories. This is of vital importance if they are to be used in any way as norms, but the author does not apparently regard them as such, but simply intends that they should stand as examples of the type of material that may be expected from the use of the test. It seems that an opportunity has been missed. If a thoroughly systematic method of arriving at the common story had been employed, it would have been possible to make more exact comparisons between individuals. In other words, some kind of standardization would have been achieved. This would have enhanced the usefulness of the test.

The manual goes on to deal with the administration of the test and the analysis of the results. A sample protocol is analysed and intercepted to illustrate the technique. Clinicians will note that this analysis of a single case covers 40 pages of the book, and the patient's first remarks: "Well, first of all, . . . " and "as far as I'm concerned, . . . " take two pages for their interpretation! The author states, however, that this analysis is more detailed than would normally be necessary, since he has endeavoured to include all the possible steps in the procedure in order to illustrate the method.

It is interesting that the author suggests a blind analysis of the protocol should be undertaken, that is, that no more of the patient should be known than his age, sex, occupation, marital status, whether he has any siblings and whether his parents are living or dead.

This book will not be as useful as the more comprehensive manual the author has promised us. RALPH HETHERINGTON.

Psychology and the Nurse By FRANK J. O'HARA. Philadelphia and London: W. B. Saunders Company, 1948. Price 14s.

This is a soulless book; it is a factual, not a dynamic text-book on psychology.

The book gives no real understanding of personality nor the living conflicts that beset it. It is full of trite advice delivered like some new psychological sermon—for instance, on p. 172, "A nurse cannot expect the world to stand still and serve her. She must adapt her desires and her life to conform to her environment, choose the proper course and act accordingly." And again, p. 108, "A nurse must learn to think and must acquire the art of thinking clearly, logically and perfectly."

Some advice is only disguised puritannical morals and is, moreover, from the psychiatric point of view, incorrect, i.e. p. 153, on Ways of Controlling Emotions, "(1) by controlling the imagination and never allowing it to reproduce any object that arouses strong emotions."

After reading this book the nurse will have amassed a good many facts about psychology clearly and simply stated. These facts may help her to pass examinations, but she will have gained no insight into herself or even her patients, and thus the book fails in its purpose. S. L. YATES.

Christianity and Fear. By OSCAR PFISTER. London: George Allen & Unwin Ltd., 1948. Pp. 575. Price 30s.

This important volume has been translated by Mr. W. H. Johnston from *Das Christentum und die Angst*, published at Zurich in 1944. It is dedicated by the author to the University of Geneva in gratitude for receiving an honorary doctorate in theology, and it bears the sub-title, "A Study in the History and in the Psychology and Hygiene of Religion."

In 1908 Dr. Pfister was offered a chair of Systematic and Practical Theology, but declined the offer on this and on several later occasions, believing that otherwise he would be diverted from using his pastorate as a basis for finding a new way to understand the phenomena of religious faith and the mutations it had undergone. He determined to devote his energies to assist those who were in psychological difficulties, and keep in contact with the practical application of psychotherapy to actual situations.

The results of the author's 36 years of study dealing with the nature and history of Christian love as applied to the problem of fear are set out. He refers to " dread " where there is an external danger, and to " fear " when the same emotion is observable within the existence of an external threat.

Although disagreeing with the at first materialistic and later agnostic background of Freud's philosophy, the author has been attracted to its scientific aspects, and has been notably impressed by the view that all neuroses are caused by a conflict of conscience which has been repressed. This led the author to consider that the grave unconscious conflicts which can exert the most powerful influence in religious and ethical life can be combated by the careful application of association and interpretation, and that the removal of neurotic traits from religion is effected in principle in the same way as the cure of non-religious neurotics.

Dr. Pfister uses the personal histories of neurotic patients to illustrate much of his material and develops his thesis in three parts. In the first he discusses the theory of fear in neurotic and normal individuals, and as a problem of collective psychology. He then considers at length the formation and solution of fear in the history of Judaeo-Christian Religion, using the theory of fear to demonstrate the terrifying psychological necessity with which distortions of the Founder's intentions take place, and he proceeds to enquire after the best remedy to be found for suffering mankind. Lastly, under the heading of the hygiene of religion, the author considers the treatment of fear within the framework of Christianity, his object being to avoid morbid distortions of the piety taught by Jesus.

With many others the author believes that mankind has been suffering because the love which constitutes its essence is sick, and has partly become strangled by peripheral egoistical tendencies and partly diverted, and hence perverted, in the direction of fear and consequently neuroses. The fault, he states, does not lie with original Christianity, " but in its neuroticization at the hands of neurotic Christians, whether theologians, clerics or laymen, and in the desublimation which occurred even when neuroses were absent."

The reader will regret that the author refers so seldom to British writers on religion. Here and there many will disagree with his argument. But Dr. Pfister's sincerity, wisdom, learning and humanity illuminate throughout this notable book. W. Norwood East.

It is with great regret that the editors learn of the untimely death on the 1st January of Dr. Brody who had established himself as a leading authority on his subject. These reviews were written while he was dying and are a tribute to the scholarship of a brave man and a measure of the loss our specialty has sustained.

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* A number of abstracts in this section are reproduced from *Chemical Abstracts* and *Psychological Abstracts*. To the Editors of these two Journals we extend our grateful thanks.

Results of Some Diagnostic Tests in Different Forms of Headache.

After a brief mention of the different criteria for the differential-diagnostic appraisal of the syndrome headache, an account is given of a histamine test with subcutaneous injection of $\frac{1}{4}$ mg. histamine chloride and a new nitroglycerin test with percutaneous application of 6 mg. nitroglycerin by means of a 2 per cent. ointment, both of which induce a vasodilator headache. The author found $\frac{1}{4}$ mg. histamine to be most suitable for the purpose of eliciting a vasodilator headache sufficiently often and yet avoid such strong reactions that it may be difficult to appraise the character of the headache. The special nitroglycerin test is introduced for the purpose of eliciting headache with the least universal reaction possible, and at the same time make the headache protracted in cases where the patient has been unable to estimate the character of a brief headache.

In a material of 171 cases, comprising chiefly a group without headache, together with groups of migraine, vasomotor headache, neurasthenic headache, psychogenic headache, and myogenic headache, the following features were found: (1) Nitroglycerin headache was thumping more often than was histamine headache. (2) There was no definite difference in the localization of the two test headaches. (3) Preparedness as to vasodilator headache was more pronounced in the nitroglycerin test. (4) There was about 50 per cent. preparedness in the group without headache; and it was just as frequent in the neurasthenic and myogenic groups, and even more frequent in the neurasthenic and myogenic groups, and even more frequent in the psychogenic group, and most frequent in the two vasodilator groups —migraine and vasomotor headache. (5) Migraine and vasomotor headache are almost 100 per cent. reproducible as to quality and a little less frequent as to localization, considerably less frequent in the histamine test. The other groups are not reproducible, which is particularly remarkable in the group of psychogenic headache, in which there was a pronounced preparedness for vasodilator headache. (6) Electroencephalography before, during and after the two tests showed no dysrhythmia. (7) Both tests are considered serviceable (*a*) for diagnosis of vasodilator headache preparedness, and (*b*) to ascertain an habitual headache as being of a vasodilator character by means of reproduction. (8) The histamine test is suitable for identification of histamine hemicrania. (9) The cases which in this material have been reproducible by means of the histamine tests have not proved particularly amenable to treatment with histamine or antihistaminica. (10) In some of the groups of this material the cases have been so few that the obtained results are to be accepted only with some degree of reservation.

(Author's abstr.)

Experiments with Epidone and Some Experiments with Other Anti-convulsant Drugs.

From these experiments the conclusion may be drawn that in this series of oxazolidinediones, tridione, didione, and epidone are the only valuable compounds in the treatment of epilepsy, as either the chemical properties of the other compounds do not allow them to be used or their anti-convulsant effect is too small.

In the author's search for anti-convulsant drugs he tried to find other series of compounds containing the CONH group twice. On the basis of the paper of Hill and Degnan (1940) and of Hamilton Anderson and S. Y. P'an (1941) about the hypnotic effect of a series of dialkylacetylbiurets the author tried to determine whether there were any anti-convulsant properties in these compounds.

The toxicity of these compounds is very low. It should be remembered that the so-called hypnophore group is present here, just as in the barbiturates.

The first compound was produced for the first time by the American authors. It is 1-n-butyl-ethyl-acetyl-biuret. It is comparatively insoluble, but the sodium salt is easily dissolved.

It has been administered perorally as 50 milligram in powder form to guinea-pigs without any anti-convulsant effect. The sodium salt has been given intravenously as 300 milligram to rabbits, also without effect.

The second: 1-n-butyl-ethyl-acetyl-5-methylbiuret has for the first time been synthetisized by the L.f. Like the first, it is insoluble, but forms soluble alkali salts. It has been administered in powder form to guinea-pigs.

Of the sodium salt 300 milligram was given intravenously to rabbits with a marked effect, although slightly less than that of epidone. The better effect must be considered due to the alkylation of the 5-carbon-atom.

As the toxicity of these compounds is very low, it seems possible that an anti-epileptic drug may be found here. However, the synthesis is even more difficult and expensive than that of epidone, and therefore further development seems barred.

The last one, 1-n-butyl-ethyl-acetyl-5-phenylbiuret, also for the first time synthetisized by the L.f., is insoluble and cannot form alkali salts. In powder form peroral doses of 50 and 100 milligrams had no effect on guinea-pigs.

(Author's abstr.)

Some Radiological and Neurosurgical Aspects of Tuberous Sclerosis.

Review of the literature and experience with the cases of this series justify the following conclusions: Gliomata in cases of tuberous sclerosis nearly invariably situated in the strio-thalamic region, are by no means rare. If a patient suffering from tuberous sclerosis develop signs of intracranial hypertension, he will much more probably harbour a neoplasm blocking one or both foramina of Monro than have a tumour elsewhere. If, on the other hand, air studies reveal a lesion of the strio-thalamic region in a patient otherwise apparently quite healthy, tuberous sclerosis should be suspected.

Radical operation has not been very successful, and palliative treatment like Torkildsen's procedure followed by X-ray treatment promises better results.

(Author's abstr.)

The Function of the Parietal Eye.

Certain features of the parietal eye: The non-spherical shape of the dioptral system, peculiar shape of the lens and retina, and aggregation of pigment in the lens have hitherto been regarded as signs of degeneration, but are only devices to prevent a proper picture-building and perceiving.

In accordance with its special development the parietal eye was never destined for sight in the same way as are the lateral eyes.

In agnaths—ostracoderms and living lampreys—and in extinct fishes the parietal eye seems to be a position-regulating supplementary static organ.

In reptiles and perhaps in extinct amphibians the parietal eye probably perceives light intensity. This stimulation influences an unknown process, perhaps of internal secretion.

In lampreys and certain reptiles the organ must be supposed to be still in complete function. (Author's abstr.)

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The Use of Electroshock Therapy in Treating Psychiatric Patients with Associated Pulmonary Tuberculosis.

1. Cases in the literature of patients developing pulmonary tuberculosis following electroshock therapy have not been adequately controlled by X-ray and clinical studies to an extent warranting definite conclusions.

2. Electroshock therapy was not found to be associated with the development of pulmonary tuberculosis in psychotic patients.

3. Case reports of 8 psychotic patients with associated active pulmonary tuberculosis who were treated with electroshock in an effort to ameliorate the psychotic symptoms so that proper therapy could be directed to the tuberculous lesion. All cases showed improvement in their tuberculosis which can be indirectly attributed to the shock therapy. (Author's abstr.)

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Brain Wave Patterns during Hypnosis, Hypnotic Sleep and Normal Sleep.

Brain wave patterns have been studied during hypnosis.

The "trance" state and suggestibility for reactions other than sleep can be established without significant alteration in the brain wave pattern. This suggestibility is associated with sleep and typical brain wave sleep patterns only if it is directed toward reduction of organism-environment integration.

Sleep, indistinguishable electroencephalographically from normal sleep in various stages, may be produced by hypnosis.

Hypnosis and sleep are special forms of organism-environment integration characterized by reduction of the integrative activity of the central nervous system.

(Authors' abstr.)

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Prefrontal Lobectomy in Schizophrenia.

The technic of a new frontal lobe operation for mental disorders is described. This operation consists in the bilateral excision of the cerebral tissue anterior to the site at which incision is made in frontal lobotomy. It has been performed on 53 patients.

The results obtained by this lobectomy in 32 cases of chronic schizophrenia are shown graphically and described in detail. The most striking results were obtained in the elimination or reduction of assaultiveness and in the elimination of soiling. Improvement in mental content was rare.

Fourteen of these 32 patients were given shock therapy preliminary to lobectomy. There was some correlation in the response to electric shock and to lobectomy. Those patients that improved after shock therapy were also more improved by lobectomy.

Only 3 of the 32 patients were not improved by lobectomy, and 1 of these has since operation become an even more difficult problem in hospital management.

Gastric motility and gastric secretion were found to be normal in these patients with schizophrenia and were not changed by operation.

The blood pressure response to drugs was not changed by lobectomy.

Gain in weight and improvement following operation were not correlated.

Minimal changes in cells were found scattered throughout the excised part of the frontal lobe. These cellular changes were the same when shock had been given, and no additional tissue abnormality was seen after shock therapy.

(Authors' abstr.)

Changes in Leukocytes of the Blood in Man after Electrically Induced Convulsions.

After electrically induced convulsions in psychotic patients a rapid and sustained fall in blood lymphocytes develops; late rises in polymorphonuclear cells and in the total leukocyte count also occur. The changes observed are consistent with the effects of increased secretion of adrenal cortex hormones.

(Authors' abstr.)

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The Effect of Certain Lesions of the Brain on Electroencephalographic Wave Patterns.

1. The localization of cerebral lesions by electroencephalography is based upon the principle of local disturbances in wave pattern incident to the effect of the lesion on the regional cortex.

2. Localizing phenomena consist not only in the occurrence of the usual delta waves and phase reversal activity, but also on variations in frequency and amplitude of generally normal waves, the super-imposition of frequencies, the production of abnormal wave sequences and quiescence or suppression of normal patterns.

3. Precise localization of cerebral dysrhythmias, particularly if verified by repeated examinations, suggest a persistent latent but non-progressive lesion (i.e., a scar). Regional dysrhythmias, on the other hand, favor the diagnosis of a provocative lesion, most likely an abscess or benign glioma. The more widespread the dysrhythmia the more active is the growth or expansion of the lesion.

4. Distant aberrations in the wave pattern as found in expanding cerebral lesions are to be accounted for on the basis of circulatory and structural reactions to the lesion (gliosis, edema), the effects of distortion and dislocation of the brain mass, the degree and acuteness of distension of the ventricular system (in whole or in part), the distant effects of pressure (contra-pressure), or transmission of abnormal potentials by way of the commissural or association systems.

5. The interpretation of any very widespread variations from the normal electroencephalographic pattern must be given careful consideration, and the possible effects of coma (sleep pattern), of hydrocephalus, of multiple lesions, or of the considerable effects of malignant tumors must all be evaluated.

6. The necessity of repeated electroencephalographic examinations in the presence of suspected focal lesions of the brain should be kept in mind, because of the frequent and even rapid changes in the electroencephalogram which occur even in slowly progressive and benign lesions.

7. A knowledge of the reactions of nervous tissues to focal lesions, and especially of the mechanical effects of expanding lesions, is helpful in the interpretation of electroencephalograms. The wide variation in the responses to similar lesions in identical situations, though still not well-understood, may be due to differences in local circulatory reactions. (Author's abstr.)

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Mesantoin in Epilepsy : A Three Year Study.

This paper reports a three year study with mesantoin in the treatment of epilepsy. Extended experience confirms the authors' earlier report. The additional test of time has established the role of mesantoin as a useful anti-convulsant drug.

Mesantoin can be used alone or in combination with other drugs. It is synergistic, particularly with dilantin, but it can also be used with dilantin and with phenobarbital.

Of 150 patients treated with mesantoin alone or with mesantoin and dilantin, a large percentage obtained some benefit. Of these, 18 were failures, 37 obtained slight to moderate improvement, 45 showed considerable benefit, and 50 derived remarkable improvement from mesantoin. Jacksonian attacks responded particularly well to this drug. *Grand mal* attacks were reduced, while *petit mal* were generally unimproved.

An average combined dose for adults is 0·4 gm. (6 grains) of mesantoin, and 0·3 gm. (4½ grains) of dilantin daily, best given as one to two tablets of mesantoin and one capsule of dilantin three times daily.

Although highly effective, mesantoin is capable of toxicity. The unfavorable reactions include drowsiness, dermatitis and occasionally blood dyscrasia. Careful clinical observation will reduce the hazards.

A small initial dose in sensitive patients, gradual increase in accordance with need and adequate amounts in those who tolerate mesantoin will yield a maximum of therapeutic benefit with a minimum of toxic effects.

There was no correlation between E.E.G. abnormalities and clinical result.

(Authors' abstr.)

Transorbital Lobotomy.

Transorbital lobotomy is most effective in patients who are relapsing after relief by shock therapy and yet not severely enough disordered to require major lobotomy. Unpublished reports indicate that it is effective in chronically disturbed schizophrenic patients, but the period of observation is too short. The same holds true for painful conditions due to organic disease. Transorbital lobotomy lends itself to performance by the psychiatrist without facilities for major neurosurgery. It is simple, swift and relatively safe. It does not result in personality down-grading comparable with that found after prefrontal lobotomy. (Author's abstr.)

Penicillin or Malaria Therapy in the Treatment of General Paralysis.

In a comparative evaluation of malaria alone and penicillin alone in the treatment of general paralysis, the impression was gained that penicillin at least equals, if it does not excel malaria therapy, when penicillin is given in sufficient amounts. Ten million units of penicillin is considered equivalent to a course of therapeutic malaria. The occasional presence of spirochetes in the brain after the administration of 10 million units of penicillin suggests that even this amount may not be sufficient, and that for safety reasons 15 million units are recommended in the treatment of general paralysis. (Author's abstr.)

Use of Sodium Pentothal in Anxiety States.

1. Anxiety states are among the most frequent conditions seen by the psychiatrist in private practice.

2. Psychotherapy alone is a long, drawn-out procedure for the treatment of the anxiety state in many cases.

3. Narcosynthesis with sodium pentothal fulfils the technique which leads to a more satisfactory result in a shorter period of time.

4. Thirty-seven cases of anxiety states that were substantially improved following sodium pentothal interviews are presented.

5. In order to ascertain the effectiveness of the treatment, additional time is required to follow the patients already studied, as well as to follow further patients in an equally intense study over a long period of time.

6. When these factors can be fulfilled to make the results conclusive, both in respect to a large enough sample and an ample period of time, a subsequent report will be published. (Authors' abstr.)

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*E.E.G. Study of Experimental Cerebro-vascular Occlusion. *Epstein, J. A., and Lennox, M. A.* 491

Organization of the Mammalian Thalamus and its Relationships to the Cerebral Cortex.

The available data concordantly suggest that the mammalian thalamus consists of three divisions different from each other in their phylogenetic and ontogenetic development, and in their relations to the cortex.

The epithalamus (paraventricular complex, habenular complex, and the pretectal group of nuclei) is entirely independent of the endbrain in all mammals and undergoes a strong reduction in higher forms.

The dorsal thalamus is entirely dependent on the endbrain. Each nucleus of this division has a restricted projection upon the endbrain without which it cannot survive. The dorsal thalamic nuclei are classified as extrinsic or intrinsic, depending on whether or not they receive a substantial portion of their afferents from extrathalamic sources. It can be shown that the neocortex of primitive mammals consists largely of projection areas of extrinsic thalamic nuclei (primary cortical areas) whereas in the neocortex of higher forms the projection areas (secondary cortical areas) of the intrinsic thalamic nuclei become dominant. The intrinsic thalamic nuclei are separable into two groups. Those projecting upon the neocortex become dominant in primates, whereas the intrinsic nuclei projecting upon the rhinencephalic structures are, on the whole, best developed in macrosomatic mammals.

The ventral thalamus consists of one subdivision (ventral lateral geniculate body) entirely independent of the endbrain, and of a second subdivision (reticular complex) which projects upon a large number of cortical fields. The sparse and generalized—though spatially well organized—projection of the reticular complex provides a system apparently independent of the dorsal thalamic projections and capable, presumably, of evoking generalized cortical activity. (Authors' abstr.)

Potential Phenomena in Thalamus and Cortex.

1. The cortical response to stimulation of an afferent path consists of two parts, a specific response indicating projection of the afferent, and a response of the alpha mechanism. The former of these, under the influence of strychnine, can be identified with the cortical spikes of paroxysmal activity.

2. The response of the geniculate and other simply arranged nuclei are monophasic spikes. The diphasic spikes of the cortex and elsewhere are inferred to be assignable to two different groups of cells related by synaptic passage.

3. The unit cell potential may be interpreted as the resultant of unequal depolarization during activity of the two ends of the cell, dendritic and axonal. If this is so, polarization by external currents should modify or even reverse the potentials, and this proves to be the case. The phenomena are comparable to the effects of polarization on nerve axons.

4. Three types of potential fields can be visualized of which different cell structures of the brain may be considered as variants. Plots of the potentials of these fields indicate what relation of potential form to structure may be expected to obtain.

5. The character of the relation between thalamus and cortex appears to be different for the specific response apparatus, which is not spontaneously active except in paroxysmal states, and the regulatory apparatus, which is normally spontaneously active but suppressed in paroxysm. It is not necessary to infer reverberating closed circuits to account for the activity in either system.

(Author's abstr.)

Electrical Activity of Subcortical Areas in Epilepsy.

The electrical activity of the cortex and subcortex were studied in 22 patients with epilepsy by means of scalp electrodes and a multi-electrode needle which was placed in the depths of the brain with the aid of a stereotaxic instrument. The instrument was designed for man, and co-ordinate measurements were obtained by studies on brains fixed *in situ*. In the present operative series the position of the needle was checked by pneumoencephalography at the end of the recording.

Analysis of records from the scalp and depths of the brain lead to the following conclusions :

1. The cortex and subcortex in epileptic patients display comparable normal and abnormal activity.

2. Like the cortex, however, various areas of the subcortex may show entirely independent abnormal activity.

3. During the induction of pentothal anesthesia 20 to 30 per second activity appeared first and remained most prominent in outer subcortical leads and showed least in leads from the central grey mass.

4. Isolated seizure discharges from the cortex are common, whereas they are rare in the subcortex. The fact that they do occur is important, because they may account for therapeutic failure in some cases where a cortical focus is ablated.

5. No case was found in which seizure discharges in or around the medial thalamus could be interpreted as initiating 3 per second wave-and-spike discharges of the *petit mal* type.

6. Primary and secondary cortical discharges have a negative sign when referred to a relatively indifferent area. An incoming volley from a distant area is registered as a positive disturbance if referred to an indifferent region.

7. Electrical sign has localizing value in electroencephalography : Negativity indicates a local disturbance ; positivity indicates a distant disturbance.

(Authors' abstr.)

Brain Stem Reticular formation and Activation of the E.E.G.

Experiments on cats have identified a cephalically-directed brain stem system, the stimulation of which desynchronizes and activates the E.E.G., replacing high-voltage slow waves with low-voltage fast activity.

This system is distributed through the central core of the brain stem and appears to comprise a series of reticular relays ascending to the basal diencephalon. Its effects are exerted generally upon the cortex and are mediated, in part, at least, by the diffuse thalamic projection system.

Possible implication of this system in the arousal reaction to afferent stimulation and in the maintenance of wakefulness is discussed. (Authors' abstr.)

Effect upon the E.E.G. of Acute Injury to the Brain Stem Activating System.

The effect upon the E.E.G. in the unanaesthetized " encéphale isolé " of acute brain stem lesions in a position to involve the ascending reticular activating system has been studied.

Elimination of the bulbar segment was without marked effect. Some synchronization followed elimination of the pons, but the most pronounced and prolonged changes occurred as a result of mesencephalic transection, or of discrete injury to the midbrain tegmentum or basal diencephalon, following which the E.E.G. activation pattern of low-voltage fast activity was reduced or abolished and the cortical record became dominated by recurring bursts or spindles of high-voltage slow waves, like those of normal sleep or barbiturate anesthesia.

Bursts could be recorded from the intralaminar and other nuclei of the thalamus, and these thalamic bursts were abolished by acute decortication. Conversely, cortical bursts were abolished by acute thalamic lesions. Possible interrelations of these regions in this activity is discussed.

These results offer an explanation for the clinical observation of somnolence following basal injury to the brain, and suggest that a maintained influence of the ascending brain stem activating system underlies wakefulness, while absence of this influence precipitates sleep. (Authors' abstr.)

Sensory Stimulation during Sleep.

1. Potentials evoked by auditory stimulation during sleep were studied on a group of patients with unilateral brain damage resulting from external trauma, cerebral vascular accident and tumor.
2. In a normal control group the response patterns from homologous areas in the two hemispheres were almost identical (except for the temporal leads).
3. In contrast with this, responses from damaged areas show a distinct distortion of the pattern. (Author's abstr.)

Electroencephalographic Study of Experimental Cerebro-vascular Occlusion.

It was possible to follow the changes in the electroencephalogram during a protracted period in a group of 29 dogs in whom the middle cerebral artery had been clipped close to its origin. A slight variation in the location of the clip was unavoidable but useful, in that the size of the resulting infarcts differed. Massive lesions included the cortex in the fronto-temporo-parietal region, the striatum, the internal capsule and the anterior portions of the thalamus and, rarely, the hypothalamus. The majority of lesions were confined to the internal capsule and to the caudate nucleus.

The clinical syndrome consisted of a contralateral spastic hemiparesis with the loss of the placing reaction and of position sense. Forced circling movements occurred towards the side of the lesion, persisting even after blindfolding the animal.

The changes in the electroencephalogram varied with the size of the lesion. In the scalp-to-ear records, slow frequencies were most conspicuous over the involved hemisphere in all types of recordings and were most prominent in recording to the contralateral ear. In the scalp-to-scalp records, flattening was evident over the frontal and temporal regions and slow frequencies were conspicuous posteriorly. Flattening was found over the entire hemisphere only in the most massive lesions and then in both types of recordings. The scalp-to-scalp records tended to become more asymmetrical after two to three weeks, the flat tracings being replaced at times by high-voltage slow frequencies. The abnormalities in the scalp-to-ear records tended to persist for the duration of the experiment. Flat records were obtained in the electrocorticogram overlying the area of infarction, and high-voltage slow waves were found in the peripheral zone. Using the multipolar needle electrodes, an unusually low voltage to flat records was obtained from the depths of the lesion.

A fairly constant change was the loss of the high-voltage 10–12 per second spindles from the fronto-central scalp electrodes and from electrodes placed on the sigmoid gyri.

The sleep records were far superior to the waking records as a diagnostic aid, the latter being of value only during the first post-operative week.

(Authors' abstr.)

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The Effect of Electroconvulsive Shock on the Anticipatory Gradient in the Rat.

Eight male albino rats were run in an 18-foot enclosed runway, until each reached a criterion of six successive daily trials expressing an anticipatory reaction. If the time consumed in the last six-foot section equalled or exceeded the time consumed in the intermediate section, the run was regarded as one indicating an anticipatory gradient. Each animal was then given two further daily trials 23 hours after electroconvulsive shock. The anticipatory reaction was almost totally abolished by this operation. A post-convulsive series of six daily trials was given. The anticipatory gradient returned with considerable uniformity.

No particular disturbance of this function was observed in a control group receiving shock to the hind legs. (Authors' abstr.).

Changes in Handedness in the Rat by Local Application of Acetylcholine to the Cerebral Cortex.

1. Acetylcholine, properly applied in suitable concentrations, has a differential effect on the cerebral cortex of the rat, as evidenced by contralateral clonic contractions and changes in preferential handedness.

2. In ambidextrous animals it may produce marked increase in the use of the hand controlled by the part of the brain which it affects.

3. In rare instances it produces partial transfers in single-handed rats by influencing a homologous mechanism to the one normally functioning. This effect has previously been accomplished only by means of practice.

(Author's abstr.)

The Runway Performance of Rats Subjected to Electroconvulsive Shock following Nembutal Anesthesia.

Twenty-four male albino rats were divided into three groups after they had learned to run in a straight alley situation. One group was subjected to electroconvulsive shock while under surgical anesthesia (nembutal). A second group was subjected to electroconvulsive shock following the injection of isotonic saline solution. A third group served as a further control, receiving the anesthetic without shock. The three groups were retested in the straight runway situation 8½ hours after experimental treatment. Running time was significantly increased in the saline-shock group. Neither the nembutal-shock group nor the nembutal group displayed disturbance. It was concluded that anesthesia protects the animal from disturbing effects of electroconvulsive shock. Such disturbances seem dependent upon the occurrence of convulsion and not upon passage of current as such. (Authors' abstr.)

Production and Reversal of Sensitivity to Sound-induced Convulsions Associated with a Pyridoxin Deficiency.

A pyridoxin deficiency was produced in suckling rats by feeding a deficient diet to the mother. The young rats were continued on the deficient diet after weaning. The animals exhibited a high incidence of sound-induced convulsive seizures. These could be prevented by injection of vitamin B_6. Middle ear infection, which may be a complicating factor in sound-induced seizures, was at a minimum and the incidence was determined by autopsy and examination of the middle ear cavity after completion of the experiments. (Authors' abstr.)

Note on Modification of Effects of Electroconvulsive Shocks on Maternal Behaviour by Ether Anesthesia.

The results of this preliminary study appear to warrant the inference that ether anesthesia at the time of passage of the electric current used to produce the typical electroconvulsive seizures in albino rats of the authors' colony complete or almost complete protection against the deleterious effect of a series of convulsive shocks from the 12th day of pregnancy to the first day after parturition. So far, the study has not been carried out beyond the descriptive level of the consequences of this treatment, but it seems clear that the results justify a thorough-going study of the mechanism whereby etherization exerts a protective influence over maternal behaviour. (Authors' abstr.)

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Diagnostic Problems in Early Schizophrenia.

(1) The present study was undertaken to aid in the early recognition of schizophrenic disorders.

(2) The procedure for the study is outlined.

(3) The evaluation of symptoms by 3 psychiatrists reveal at times wide discrepancies regarding the presence of certain schizophrenic symptoms. There is greater agreement on psychoneurotic symptoms.

(4) The results suggested that the schizophrenic symptoms most prevalent are preoccupation, loss of affect, incongruity of emotional reaction, defective insight and blocking.

(5) The Rorschach examination is helpful in determining the schizophrenic disorder and in some cases was first to suggest the more severe disturbance.

(6) The failure to establish the diagnosis of schizophrenia is occasionally the result of (*a*) inadequate history, (*b*) minimizing certain signs pathognomonic of psychotic behavior, and (*c*) the presence of many psychoneurotic symptoms occasionally obscuring the mild but significant symptoms of the more serious illness.

(7) Three case-histories are included, with Rorschach studies and discussion.

(8) The term " chronic incipient schizophrenia " is introduced to denote cases that appear to represent a prolongation of the incipient stage of schizophrenia, and which are occasionally mistaken for severe psychoneuroses.

(Authors' abstr.)

Cerebral Concussion : A Psychosomatic Survey.

Uncomplicated cerebral concussion is often difficult to differentiate from emotional fright reactions and traumatic neurotic reactions. A series of physical and subjective symptoms is given in the interests of a better differential diagnosis.

(Author's abstr.)

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Mass Action versus Mosaic Function of the Frontal Lobe.

Any theory that presumes to explain the actions of the frontal lobe must include the normal development of such functions from infancy to maturity. Simple movements known to be under the control of the frontal motor cortex are elaborated into mechanical skills, social, occupational, recreational and creative skills. Simple visceral sensations are elaborated into internal and external orientation, and on into social and spiritual self-consciousness, with creative ecstasy as the highest achievement of the functioning individual. Since this creative ecstasy is the only function apparently destroyed by transorbital lobotomy, it may safely be attributed to the most anterior portions of the frontal lobes. (Author's abstr.)

Cytological Changes in Nerve Cells in Dementia Praecox.

Pathological changes in nerve cells in cerebral cortex of 42 patients with dementia praecox, 6 with manic depressive psychosis, and 2 with general paresis were studied in the pieces of prefrontal cortex removed at the time of prefrontal lobotomy. A special stain was used which stained desoxyribonucleic acids in nuclei and unmasked the inclusion bodies in cytoplasm. Three stages of nerve cell disease were revealed.

The first stage showed nerve cells with intact cytoplasm occupied by a small number of inclusion bodies. Their nuclei were deformed and filled with great amounts of ribonucleic acids. The second stage was represented by nerve cells with highly vesicular nuclei, and with enlarged nucleoli actively producing ribonucleic acids on their surface. The cytoplasm was filled with inclusion bodies and was breaking down. Microglia and astrocytes were usually associated with these cells. Repair of damaged cytoplasm seemed to be the main feature of the second stage. The third stage was represented by naked nerve cell nuclei devoid of cytoplasm and inclusion bodies. Inclusion bodies stained a deep blue indicating that their basic content was a ribonucleic acid. The extruded inclusions were embedded in walls of small blood vessels where they underwent fatty and argentophile degeneration. (Authors' abstr.)

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*Central Inhibitory Effects of Carbon Dioxide. *Pollock, G. H.* 315
*A Cerebello-bulbo-reticular Pathway for Suppression. *Snider, R. S., et al.* 325
*Facilitation Produced by Cerebellar Stimulation. *Snider, R. S., and Magoun, H. W.* 335
*Respiratory and Vascular Responses in Monkeys from Temporal Pole, Insula, Orbital Surface and Cingulate Gyrus. *Kauda, B. R., et al.* 347

Functional Localization of Central Co-ordinating Mechanism for Emesis in Cat.

Vomiting has been elicited in 11 out of 20 cats in which the lower brain stem was stimulated faradically with a bipolar needle electrode manipulated with the aid of the Horsley Clarke stereotaxic instrument. Decerebrate preparations were used in all experiments since anesthesia severely depresses emesis. The graphic response, as recorded with thoracic and abdominal pneumographs, is characterized by an unsustained apneusis ; its early fall signals the expulsion of vomitus.

Stimulating current thresholds for the vomiting response are such that the intensity threshold is about 8 volts and the frequency threshold is in the neighborhood of 50 impulses per sec. Although the response is not abolished by vagotomy, the latent period is prolonged.

By histological study of serial sections of the medulla, the responsive points for emesis have been identified and localized to the region corresponding to the solitary fasciculus and nucleus, and the dorsolateral border of the lateral reticular formation.

The close anatomical relationship of this reactive region to the medullary loci for salivation, spasmodic movements, forced inspiration, and vasomotor responses reflects the intimate functional involvement of these loci in the expression of the complex physiological pattern of emesis.

The definition of a " center " is discussed, and it is suggested that the reactive area includes a vomiting centre. (Authors' abstr.)

Central Inhibitory Effects of Carbon Dioxide.

1. High concentrations of carbon dioxide in oxygen increases the frequency, but lowers the amplitude of the normal cat E.E.G. The E.K.G. is speeded up by 15 per cent. carbon dioxide—85 per cent. oxygen, but 30 per cent. carbon dioxide—70 per cent. oxygen definitely slows it (after an initial rise) and causes reversible irregularities to appear.

2. Carbon dioxide antagonizes seizures induced by Metrazol and by electricity. It is found that 30 per cent. carbon dioxide is more effective than 20 per cent. and this is more effective than 15 per cent. and so on down through 5 per cent. carbon dioxide. The antagonism is present in low and high partial pressures of oxygen. Hyperventilation, pure oxygen and high oxygen partial pressures in nitrogen seem to enhance the convulsive response to electric-shock, whereas low oxygen (6 per cent.), even without carbon dioxide, and 100 per cent. nitrogen shows antagonism to seizure activity.

3. Length of administration of the gas mixture and strength of stimulus applied appear to be important factors to consider in addition to concentration of carbon dioxide.

4. Utilizing the technique described, the cerebellum does not respond with seizures to electrical stimulation. (Author's abstr.)

A Cerebello-bulbo-Reticular Pathway for Suppression.

1. Studies on the suppression of reflexly-induced and cortically-induced (cerebral) movements by electrical activation of the anterior cerebellar lobe, and paramedian lobules plus nearby folia are reported.

2. Frequencies of 200 to 300 pulses per sec.—usually 300 per sec.—were found to be most effective for cerebellar stimulation.

3. The pathway concerned with suppression from the cerebellum is : cerebellar cortex to nucleus fastigii to bulbar reticular formation, thence to the spinal cord via the reticulo-spinal tracts.

4. Evidence is presented which shows that the suppressor areas, the facilitatory areas, and the tactile areas of the cerebellum are practically coextensive. (Authors' abstr.)

Facilitation Produced by Cerebellar Stimulation.

Facilitation of reflex activity and of movements evoked from the cerebral cortex was elicited by stimulation of (i) anterior lobe-lobulus simplex region, and (ii) paramedian lobule-tuber vermis-pyramis region of the cerebellum.

It was easier to elicit the effects in monkeys than in cats.

The most pronounced effects were obtained when chloralosane anesthesia was used and electrical stimuli of 200 to 400 cycles per sec. were applied to the cerebellum from 5 to 15 seconds before the elicitation of the reflex or cerebral-induced movement.

Subthreshold cerebral stimuli may become threshold stimuli if either of these two regions of the cerebellum are adequately activated.

Post-stimulatory inhibition and prolonged facilitation were frequently observed. The role of facilitation in cerebellar function is discussed. (Authors' abstr.)

Respiratory and Vascular Responses in Monkeys from Temporary Pole, Insula, Orbital Surface and Cingulate Gyrus.

1. Results of electrical stimulation of temporal and frontal lobes and the insula of monkeys with recording of vascular and respiratory responses are reported.

2. Square-wave pulses of low intensity (3–8 volts) and of varying frequency and pulse duration were used.

3. From temporal pole blood pressure alterations and respiratory inhibition were obtained. The optimal parameters of stimulation were found to be a frequency of about 40 per sec. and prolonged pulse durations (10 msec.).

4. With these optimal parameters similar vascular and respiratory responses were obtained from a continuous stretch of cortex extending through the anterior insula, the posterior orbital surface of the frontal lobe, the subcallosal region to the rostral limbic gyrus and also including basal olfactory structures (uncus, limen, insulae, anterior perforated space).

5. The lateral surface of the frontal lobe (including the depths of the arcuate sulcus and principal sulcus) was explored, but even with greater intensities of stimulation (15 volts) only inconstant respiratory changes were obtained from the cortex dorsal to the superior limb of the arcuate sulcus and ventral to its inferior limb.

6. The continuous responsive region is covered either by allocortex or by agranular or sparsely granular isocortex showing characteristics of transitional cortex.

7. The relevant connections of these areas are discussed. (Authors' abstr.)

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*Electronarcosis. I, Inhibition of Electrical Activity of the Cerebellum. *Gualtierotti, T., et al.* 363
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*Stimulation of Anterior Limbic Region in Dogs. *Clark, G., et al.* . . . 459
*Physiological Studies on Mechanisms of Color Reception in Normal and Color-blind Subjects. *Motokawa, K.* 465
*Physiological Induction in Human Retina as Basis of Color and Brightness Contrast. *Motokawa, K.* 475

Electronarcosis : I, Inhibition of Electrical Activity of the Cerebellum.

1. Square-wave stimulation of the diencephalon causes complete or almost complete suspension of cerebellar electrical activity. Potentials reappear suddenly after 15–20 minutes according to the duration and intensity of the current applied to the diencephalon, the reappearance of cerebellar electrical activity is characterized by waves of smaller amplitude gradually or occasionally by bounds.

2. In some cases (together with the disappearance of the normal E.C.G.) it is possible to obtain alpha oscillations. They are not of cerebellar origin, but are transmitted by the cerebral cortex in an increased state of electrical activity.

3. Application of the same stimulus directly to the cerebellar cortex brings about the phenomenon of inhibition only in the zone between the electrodes. Even a few mm. outside the electrodes no appreciable modification of electrical activity is apparent.

4. The reflex and segmental nature of the inhibition is evident in both the spinal cord and the cerebellum. The inhibitory center has been topographically determined by applying the current in different zones of the cerebellar cortex, after sectioning progressively more caudally in the encephalic trunk. The phenomenon of inhibition disappears completely when the section is performed in the most cranial part of the pons.

5. After this last section the spontaneous oscillations of cerebellar potential increase markedly. This is interpreted as being due to the cessation of a physiological state of inhibition.

6. The existence in the encephalic trunk of a center regulating cerebellar electrical activity is postulated, similar to what we have seen in the spinal cord. This center spreads cranially as far as the cranial limit of the pons. The anatomical zone of the center which regulates cerebellar inhibition is limited to the most caudal part, inferior to the spinal cord which is higher in the mesencephalon. Inhibition of the cerebellum lasts longer (20–30 min.) than that of the spinal cord. (Authors' abstr.)

Production of Postural Tremor.

In a series of monkeys with injury to various parts of the midbrain and pons, postural tremor resulted when lesions were present in the ventral tegmentum of the midbrain, dorsal to the central part of the substantia nigra. If the lesion was unilateral, tremor was present on the opposite side. Lesions involving this critical area, but extending also beyond it, did not produce postural tremor. Such tremor did not follow injury to other regions of the anterior brain stem, but did not occur after lesions of the cerebellar nuclei.

Electromyography of postural tremor in these monkeys showed regular alternation in agonists and antagonists at rates of 6-8 sec., augmentation during excitement, disappearance of tremor during active movement, and absence of a single frequency of tremor for the whole body.

Action tremor was encountered in a number of monkeys, the common feature of whose lesions was injury to the superior cerebellar peduncle. Electromyography of action tremor showed more dispersed bursts of potentials, occurring less frequently and regularly than in postural tremor, and without clear-cut alternation in agonists and antagonists.

Observations bearing upon hypokinesia, comatose states and spasticity following anterior brain-stem lesions are also prepared. (Authors' abstr.)

Autonomic Effects on Stimulating Rostral Portion of Cingulate Gyri in Man.

This report marks the first effort to compare the effects of stimulation of the rostral cingular cortex in man with those obtained in laboratory animals. It appears that some of the functions attributed to the anterior cingular cortex in the laboratory animal are also represented in the corresponding region in man, notably representation of autonomic functions related to blood pressure and cardiac and respiratory rates. More careful mapping of this region is obviously required, together with continuous recording of autonomic changes and simultaneous records of the electrical activity of the cortex. A more dependable cortical stimulator must be used, and other autonomic responses such as sweating, pupillary changes and bladder activity should also be observed. (Authors' abstr.)

Electric Potentials Generated by Antidromic Volleys in Quadriceps and Hamstring Motoneurones.

Maximal antidromic volleys have been fired into quadriceps or hamstring motoneurones, and the action potentials so generated have been recorded by an indifferent electrode and a micro-electrode. The micro-electrode has been inserted by a micro-manipulator along a series of tracks lying in one transverse plane through the spinal cord and either through or adjacent to the motor nucleus. Information derived from the micro-manipulator and subsequent histological examination enabled transverse maps to be constructed, showing accurately each track and the positions along it at which antidromic potentials were recorded.

An attempt has been made to analyse such antidromic potentials into that fraction generated by the antidromic impulse travelling in the motor axons and that attributable to antidromic invasion of the soma and dendrites. This analysis has largely been based on the postulate (supported by all relevant experimental evidence) that antidromic transmission is blocked at the axon-soma junctions of many motoneurones, such blockages occurring in more motoneurones during the depressive action of a conditioning antidromic volley, and in fewer during facilitation by synaptic excitatory action. Hence the components of the antidromic potential revealed to be labile by such tests are attributed to antidromic invasion of the somas and dendrites, while the initial positive non-labile spike would be generated by the antidromic volley in the axons.

Antidromic invasion of quadriceps motoneurones sets up a labile spike-like negativity of a micro-electrode lateral and ventral to the motor nucleus, while dorsal and medial there is an inverse potential. It is postulated that the dendrites are preponderantly distributed dorsally and medially, and that, when the antidromic impulse invades the soma and dendrites of a motoneurone, its propagation eventually fails towards the dendritic terminals, which consequently act as sources for the sinks on the soma and proximal dendrites. The axon also then acts as a source.

On the contrary, antidromic invasion of hamstring motoneurones sets up currents largely flowing in "closed fields" almost as much as with the hypoglossal nucleus.

With an intra-nuclear micro-electrode there is often a large labile positive potential during antidromic activation of the motoneurones. This is attributed to injured motoneurones, and is shown to be produced by one or a few motoneurones very close to the micro-electrode. Investigations are described on such antidromic responses of single motoneurones.

Consideration of the geometrical factors encountered in antidromic propagation provides an explanation of the blockage or delay at the axon-soma junction as well as of the postulated slowing and blockage towards the dendritic terminals. However, it appears that the spike responses of the soma and dendrites is at least 1 msec. in duration and hence about doubles that of the axon. This longer duration and the oscillatory activity show that, apart from geometrical difference, the excitatory properties of the soma and dendrites differ to some extent from those of the axon.

(Authors' abstr.)

Electrocorticograms of the Cytoarchitectural Areas.

Simultaneous direct cortical recordings of electrical activity from cytoarchitectonic areas revealed marked differences. The patterns in areas FA and PC are distinct from those of the rest of the cortex, but are indistinguishable from each other. The activity in OC, OB, and OA is essentially the same except that the amplitude is higher in OA; the activity in the occipital region is of much lower amplitude than in other regions of the cortex. Activity from TA is similar throughout the entire area—as is the activity of FA and of PC. Activity from FD is usually of low amplitude and has a uniform slow frequency with faster activity superimposed. The activity of FB is high amplitude and resembles the activity from the inferior parietal region. Simultaneous recordings from the heterotypical koniocortices revealed similar activity in PB and TC which resembled the activity of the central region, but was unlike that of OC. Parietal areas (notably PEm, PE, PF and Pg) revealed minor differences, but the activity from that general region was essentially the same everywhere. The authors were not always able with certainty to recognize the activity of FD, FB, TA, PEm, PE, PF and PG. Electrical studies of the cortex of the chimpanzee reveal similar findings under Dial anesthesia.

There are significant differences in the electrical activity derived from some areas of the cortex of the monkey (notably FA, PC and OC, OB), while the differences in the activity of other areas are minimal; the authors have been unable to correlate the type of activity with the cytoarchitecture of the latter areas.

(Authors' abstr.).

Proprioceptive Modification of Reflex Patterns.

Afferent stimulation of several peripheral nerves in cats and monkeys under Dial (Ciba) elicited specific response patterns (EMG's) in leg muscles. Proprioceptive modification of these patterns was achieved through (*a*) fixation of joints to extend certain muscles, and (*b*) directly loading specific muscles.

1. The biceps complex (Bi-EC-BR) customarily responds to afferent stimulation of the superficial radial, ulnar, dorsal, cutaneous (branch of ulnar) and median nerves.

2. The triceps complex (Tri-FC-) responds to afferent stimulation of cutaneous antibrachii medialis nerve.

3. Afferent stimulation of the medial plantar nerve consistently excites a strong response in tibialis anticus. A hamstring's response is frequently associated with it, but its EMg is weaker. The quadriceps, gastrocnemius, and soleus are silent or nearly so.

4. Stimulation of the sural nerve typically results in strong excitation of the gastrocnemius and hamstrings, with the quadriceps and tibialis silent and with the soleus showing only a slight response.

5. The response (to afferent nerve stimulation) of the entire Bi-EC-BR complex is augmented by fixation of the elbows at an obtuse angle. This effect is attributed to the development of greater tension in the biceps and so to stronger excitation of proprioceptive endings within.

6. The Bi-EC-BR complex is facilitated also by fixation of the wrist in volar flexion. The facilitation is attributed to proprioceptive reflexes arising in the stretched extensor carpi as actual tension develops.

7. Loads directly applied to the biceps or to the extensor carpi facilitate the reflex response of the Bi-EC-BR complex.

8. Fixation of the elbow at an acute angle facilitates the reflex response of the Tri-FC complex due to enhanced proprioception in the stretched triceps.

9. Fixation of the wrist in dorsiflexion facilitates the reflex response of the Tri-FC response through enhanced proprioception in the carpal component of the complex.

10. Fixation of the ankle in plantar flexion (stretching the tibialis) facilitates the tibialis-hamstrings reflex response. A load on the tibialis tendon has the same effect.

11. Fixation of the ankle in dorsiflexion enhances the reflex response of the hamstrings and the gastrocnemius. A load on the gastrocnemius portion of the Achilles tendon has a similar effect.

12. The facilitation of synergists and " associated synergists " by the means described is often accompanied by a reciprocal inhibition of antagonists, as illustrated by the inhibition of a reflex response of the tibialis by a load on the gastrocnemius.

13. Co-innervation of an antagonist may be brought about by intense proprioceptive facilitation of the agonist (with the antagonist at a corresponding disadvantage).

14. It is emphasized that the proprioceptive " facilitation patterns " are the same as the activity patterns (muscle groups) elicited by cortical stimulation, by reflex (afferent nerve) stimulation, and by the passive stretch of muscles.

(Authors' abstr.)

Excitability of Cortical Afferent Systems during Barbiturate Anesthesia.

Pentobarbital anesthesia of increasing depth causes increasing lengthening of the absolutely unresponsive period (AUP) of the somesthetic pathway as measured at its cortical terminus. This effect is reversible. When the evoked response at the cortex is diphasic, the second, i.e. the negative, deflection has the longer AUP. The excitability curve rises smoothly from the end of the AUP and attains a plateau without either supranormal or subnormal periods.

When the curve has reached the level of normal excitability, it is depressed from the predicted plateau in the presence of thalamo-cortical after-discharge and by 8–12 per sec. " bursts " of spontaneous activity. When anesthesia is light the curve is also depressed by some elements of the background activity. Other spontaneous potentials do not affect the evoked response.

It is concluded that thalamo-cortical after-discharge, " burst " activity, and some of the background waves recorded at the lighter levels of anesthesia travel in neurones of the somesthetic pathway. By the development of refractoriness in these neurones they tend to block evoked potentials. It is suggested that the disappearance of the interfering rhythms when anesthesia is deep may result from the narcotic process which lengthens unresponsiveness in the thalamus.

(Author's abstr.)

Stimulation of Anterior Limbic Region in Dogs.

In ten dogs electrodes were implanted aseptically on the motor cortex and in the anterior limbic region. Stimulation of these sites in the unanesthetized state yielded no evidence of suppression although this phenomenon was demonstrated under Dial anesthesia. No explanation is advanced for this difference which gives no clue to the functional importance, if any, of suppression. (Authors' abstr.)

Physiological Studies on Mechanisms of Color Reception in Normal and Color-blind Subjects.

From studies of the change in electrical excitability of the eye following a brief illumination, time constants characteristic of the basic retinal processes were determined. The wave-length dependence of the magnitude of these processes was studied in various regions of the retina in normal and deuteranomalous trichomats. At the fovea, three kinds of processes with their own preferential regions at 590, 550 and 460μ of the spectrum were found and named R, G and B processes respectively.

In the periphery, a new independent process, Y, with its maximum in the yellow part of the spectrum was found. The order of dominance of these processes as measured by their maximum magnitudes was found to be as follows: $G>R>B$ in the fovea, $Y>B>G>R$ at 15° from the fovea, $B>Y>R>G$ at 25° and 35° from the fovea.

In the deuteranomalous subject, the development of the G process was especially weak.

At the fovea of dichromats only two kinds of processes were found, of which one showed the same spectral sensitivity as the B process in trichromats, but the other was found different according to the kind of color blindness. The process corresponding to R of trichromats was absent in the protanope, and no process corresponding to G was found in the deuteranope.

The retinal processes were further analysed by the method of selective inhibition. (Author's abstr.)

Physiological Induction in Human Retina as Basis of Color and Brightness Contrast.

The electrical excitability of the human eye was measured under weak light adaptation at varying intervals after exposure to a bright patch, taking electrical phosphene as the index. The increase in electrical excitability after exposure to the test-patch was expressed in percentage of the resting level and denoted by ξ.

1. It was found that the ξ values were always greater when a black patch and the white test-patch were presented in succession than when the white patch was presented alone. No such striking increase in ξ values was found, when, instead of using the black patch, the whole visual field of the subject was temporarily darkened. Therefore this phenomenon is not due to dark adaptation, but due to successive brightness contrast.

2. When the dark and the bright patch were presented simultaneously in juxtaposition, the ξ values were found always greater than when the bright patch was presented alone (simultaneous brightness contrast).

3. The excitability curve, which represents the time course of ξ variation after removal of the test light, was changed in a characteristic manner by application of spectral light prior to the white test-light. The excitability curve for the white light preceded by yellow light was found to be the same in character as the excitability curve for blue light, and successive presentation of blue and white light gave rise to the same excitability change as was caused by a single presentation of yellow light. It is obvious that this phenomenon represents a physiological aspect of successive color contrast.

4. It was shown that a color triangle could be constructed from the data obtained from the experiment of wave-length dependence of ξ-magnitudes and from that of successive color induction, and that the hue and saturation of induced colors could be described precisely by this geometrical expression of the data.

5. Spatial color induction was proved in three ways, and the peripheral nature of the phenomenon was suggested on the basis of the findings obtained from an hemianoptic patient. (Author's abstr.)

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*Clinical and E.E.G. Studies of Prisoners Charged with Murder. *Stafford-Clark, D., and Taylor, F. H.* . . . 325

Experimental Investigation of the Connexions of the Olfactory Tracts in the Monkey.

1. The central connexions of the olfactory tracts have been determined experimentally in three macaque monkeys and two Guinea baboons by following with a silver method the degeneration of fibres and terminals which results from unilateral transection of the olfactory peduncle.

2. It was found that the lateral olfactory tract terminates mainly on the dorsal surface of the temporal lobe, in the superficial layer of the prepiriform cortex which forms the anterior part of the hippocampal gyrus. Some fibres of the tract terminate in the prepiriform cortex lying on the orbital surface of the frontal lobe (which is very restricted in primates), in the olfactory tubercle, and in the peri-amygdaloid area. The primary olfactory areas have been mapped out on the surface of the macaque brain.

3. Only the cortico-medial group of nuclei of the amygdaloid complex receives fibres from the olfactory tracts, not the basolateral group. Olfactory fibres are

bilaterally distributed by way of the anterior limb of the anterior commissure to the nucleus of the stria terminalis (the main part of which lies in the preoptic region), and to the central amygdaloid nucleus.

4. No olfactory fibres could be traced to the septum, the entorhinal area, or any part of the hippocampal formation in the lateral ventricle. A few fibres from the tract reach the superficial layer of the anterior hippocampal nucleus.

5. It is evident that in primates the general pattern of distribution of olfactory fibres is similar to that in lower mammals, although the primary olfactory areas have been displaced and have become relatively much reduced in the course of evolution. (Authors' abstr.)

Degeneration of the Granular Layer of the Cerebellum.

Selective degeneration of the granular layer of the cerebellum is described in eight cases of visceral carcinoma, four cases of hypo- or hyperglycaemic coma, and four cases of amaurotic idiocy. The pathogenesis of the lesion is at present obscure, but attention has been directed in this paper to the possibility that some disturbance of metabolism, possibly a nutritional deficiency, is responsible for the degeneration. (Authors' abstr.)

Clinical and Electroencephalographic Studies of Prisoners Charged with Murder.

A clinical and electroencephalographic study of 64 prisoners charged with murder suggests that a significant correlation exists between apparently motiveless crime and electroencephalographic abnormality. While this abnormality is not specific, it has been found in over 70 per cent. of prisoners whose crimes appeared motiveless, but who were otherwise clinically sane and normal. The indications for further investigations of convicted prisoners falling into this group, and for their preventative detention, are discussed. (Authors' abstr.).

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Some Observations on Alcohol Metabolism with Radio-active Ethyl Alcohol.

Investigation of alcohol metabolism in the rat with the help of radio-active C^{14} ethyl alcohol has revealed the following information.

(1) Intact animal experiments. Rate curves for the combustion of alcohol to carbon dioxide following a 1-g. per kg. oral dose: (*a*) 75 per cent. oxidized in 5 hours; (*b*) 90 per cent. oxidized in 10 hours; (*c*) no acceleration of complete alcohol oxidation in alcohol-habituated rats or in animals receiving pyruvate.

(2) Tissue slice experiments. Carbon dioxide formation from alcohol: (*a*) Liver and kidney, rapid oxidation; (*b*) heart and diaphragm, slight activity; (*c*) brain, no activity; (*d*) all organs, same degree of alcohol oxidation in normal and alcohol-habituated rats; (*e*) no stimulation of oxidation in liver by pyruvate.

(Authors' abstr.)

Alcoholism as a Psychosomatic Disorder. I, Endocrine Pathology of Animals and Men Excessively Exposed to Alcohol; Its Possible Relation to Behavioral Pathology.

The authors' clinical impressions, together with a review of experimental data, lead them to believe that alcoholism, directly or indirectly, produces endocrine insufficiency, especially of the adrenal cortex. Alcohol appears to be in itself a "stressful agent." By its anesthetizing effects on the central nervous system it can predispose to the non-specific stresses of trauma, malnutrition and infection, each of which predisposes to the others and to financial privation. The latter, in turn, increases the possibility of malnutrition and, following on alcoholism as it does, invites social disapproval and self-condemnation, which add to already present emotional stress in the individual. Social disapproval and self-condemnation (loss of love) also follow upon the "disgraces" associated with public intoxication and its sequels, including medical care, hospitalization or legal prosecution.

The repeated exposure to stress results in stimulation of the pituitary (*via* adrenal medullary secretion, sympathetic nervous system pathways or other paths) with consequent repeated adrenal cortex stimulation and eventual glandular exhaustion. An antagonism between alcohol and sexual hormones (19, 20, 61) may lead eventually to relative gonadal failure. This possibly throws an additional burden on the adrenal cortex. Adrenal cortex hyperactivity (together with increased thyroid function, directly or indirectly provoked by alcohol) plus malnutrition contribute to liver damage (62). The latter, at least in the male, further jeopardizes normal gonadal function by failure to inactivate estrogens, and leads to suppression of function of the testes and the pituitary.

At the same time malnutrition serves to withhold dietary constituents necessary for normal adrenal cortex function and repair, e.g. ascorbic acid. Absence of certain fractions of the vitamin B complex may even serve to provoke hyperfunction in the already exhausted gland. Any tendency toward thyroid hyperfunction as compared to the capacity of the adrenal would tend to accentuate the adrenal insufficiency.

An organism prone to alcoholism seems to be one that needs the initial effect of alcohol as a "stressful agent" in order to make temporary adaptations to an environment with which it cannot cope adequately. This need may be either on the basis of neurosis (with intermittent relative adrenal cortex "fatigue") or on the basis of other constitutional or acquired factors. The initial use of alcohol may be fortuitous; its choice after the original introduction is predetermined. Continued excessive use of alcohol is itself a means of constitutional alteration.

Alcoholism, then, by this hypothesis, is in some persons a self-perpetuating progressive disease in which the organism first invites the noxious agent (alcohol) because of its helpfulness in stimulating needed secretory response of the adrenal cortex and then requires the same agent with increasing constancy to achieve the desired result because of its proclivity to produce pluriglandular dysfunction. Because certain mental illnesses appear to be directly the result of alcoholism, certain of these—which seem basically similar to "functional psychoses"—if related to the concomitant endocrine metabolic changes may provide correlations greatly increasing our understanding of the mentally ill and our ability to treat them.

(Authors' abstr.)

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1. Biochemistry, Physiology, Pathology, etc.

The Chemical Equilibrium of Distribution of Acetylcholine in the Brain Tissue of Warm-blooded Animals. Hobbiger, F., and Werner, G. [Z. Vitamin-, Hormon- u. Fermentforsch., **2**, 234–52 (1949) (in German) ; *cf. C. A.,* **42**, 6464*g*, 6872*h* ; Loewi, et al., *C. A.*, **32**, 9128^7.]

In comminuted tissue of the central nervous system of warm-blooded animals (adult white mice were used in these experiments), a chemical equilibrium exists between free and bound acetylcholine (1). The addition of (1) to the material at a pH at which the bound (1) is liberated by $CHCl_3$ causes a decrease in the free extractable (1) without a corresponding increase in the (1) content of the rest fraction. With an extraction fluid containing $CHCl_3$ all the added (1) is regained. Conclusion : A 3rd unknown form of (1) is also present.

Erich Hirschberg (Chem. Abstr.).

An Ether-soluble Form of Acetylcholine in the Central Nervous Sytsem of Warm-blooded Animals. Hobbiger, F., [Z. Vitamin-, Hormon- u. Fermentforsch., **2**, 253–8 (1949) (*in German*) ; *cf. Loewi, et al., C. A.,* **32**, 2226^2 ; **42**, 6872*h*.]

The central nervous system of white mice was placed for 1 hour at room temperature in Ringer solution containing 1 : 10,000 eserine, washed with eserine-free Ringer solution, dried, and ground with quartz sand in 10–25 ml. ether. After the extractant was removed, the residue was taken up in Ringer solution and heated to boiling for 10 minutes to liberate acetylcholine. The average content of free and bound acetylcholine was 1·0 and 1·5 γ/g. nerve tissue, respectively. About 1/6–1/7 of the total content was not free in the tissues, but in a bound form, presumably with lipides. Erich Hirschberg (Chem. Abstr.).

Acetylcholine Synthesis in Brain Tissue. Hobbiger, F., and Werner, G. [Arch. Intern. Pharmacodynamie, **79**, 221–30 (1949).]

Brain pulp, incubated for 15 minutes and then treated with eserine, synthesizes acetylcholine. Small amounts of acetylcholine chloride, added with the eserine, increase the rate of synthesis. M. L. C. Bernheim (Chem. Abstr.).

The Effect of NU 683 *on the Excitability of the Vagus and the Sensitivity of the Heart to Acetylcholine. Caldeyro Barcia R. and Austt, E. Garcia. [Arch. Intern. Pharmacodynamie,* **80**, 89–94 (1949).]

After doses of NU 683 which inhibit the pseudocholinesterases the heart is slightly more sensitive to vagus stimulation and much more sensitive to acetylcholine. M. L. C. Bernheim (Chem. Abstr.).

The Effect of NU 683 *on the Sensitivity of the Carotid Body to Acetylcholine. Mazzella, H., and Migliaro, E. [Arch. Intern. Pharmacodynamie,* **80**, 79–81 (1949).]

Doses of NU 683 which inhibit the pseudocholinesterases sensitize the carotid body of dogs to acetylcholine. M. L. C. Bernheim (Chem. Abstr.).

Action of Acetylcholine on Medullar Excitability. Sanchez, Ramon Dominguez. [*Rev. espan. Fisiol.*, **4**, 131–41 (1948).]

Experiments were performed on cats anesthetized with 0·80 g. chloralose per kg. body weight. Intravenous injection of 2 or 3 mg. acetylcholine (I) into an animal previously treated with 0·5 mg. eserine sulfate (II)/kg. body weight, and 1 mg. atropine sulfate (III) /kg. body weight, sometimes resulted in strengthening of the homolateral flexor reflex. Doses of about 1 mg. (I) at times depressed reflex activity, occasionally only transiently, when following (II) or (III). The usual response to 0·2–1 mg. (I) was a transient depression of reflex activity followed by a prolonged stimulation. MARSHALL E. DEUTSCH (Chem. Abstr.).

Distinction between Acetylcholine Esterase and Other Choline Ester-splitting Enzymes. Augustinsson, Klas B., and Nachmansohn, David. [*Science*, **110**, 98–9 (1949).]

The choline ester-splitting enzymes are divided into two groups. The prototype of the first group is the acetylcholine esterase found in all conductive tissue (nerve and muscle) and in erythrocytes. It has a high affinity for acetylcholine (small Michaelis constant) and a high turnover number. The enzyme splits propionylcholine at the same or at a lower rate, butyrylcholine, at a low rate or not at all, and non-choline esters are not split or at a low rate. Esterases with similar characteristics occur in snake venom, *Helix* blood and in the electric tissue of *Electrophorus electricus* (cf. A., *C. A.*, **42**, 5063*g*). The second group includes the esterases found in some serums and in the pancreas. They are true choline esterases in that they split choline esters at a higher rate than non-choline esters. These choline esterases have a high Michaelis constant for choline esters. They are not inhibited by high concentrations of acetylcholine, as is acetylcholine esterase. Hydrolysis rate increases with increasing length of the acyl chain from acetyl to butyryl.
H. G. STEINMAN (Chem. Abstr.).

Acetylcholine and Neuronal Activity in Epilepsy. Cone, Wm. V., Tower, Donald B., and McEachern, Donald. [*Trans. Am. Neurol. Assoc.*, **73**, 59–63 (1948).]

Acetylcholine, assayed on the isolated ventricle of the mollusk, was found (concentration 0·02–5γ per cent.) in the cerebro-spinal fluid of 77 per cent. of 57 epileptic patients, and of 17 per cent. of 54 non-epileptic persons.
MARION HORN PESKIN (Chem. Abstr.).

The Detection of Acetylcholine in Cerebrospinal Fluid, especially in Psychotics. Coloma, Tomas Alcober. [*Arch. Psychiat. Nervenheilk.*, **180**, 202–5 (1948) ; *cf. C. A.*, **42**, 8927*a*.]

Acetylcholine was detected by a biological method in the cerebrospinal fluid in 21 of 32 mental patients. WARREN M. SPERRY (Chem. Abstr.).

Influence of Adenosinetriphosphate on the Blood Vessels of Frogs, and its Effect in the Presence of Acetylcholine. Meiners, Sigisbert. [*Arch. ges. Physiol.* (*Pflugers*), **251**, 1–17 (1949).]

Specimens of *Rana temporaria* and *R. esculenta* were kept 24 hours at 2–4°, decapitated, and pithed, and then kept another 1 or 2 hours at this temperature before use. After careful excision of the cloacas, the experiments were performed by perfusion of the preparations at a pressure of 15–25 cm. H_2O with Ringer solution (I) buffered at pH 7·4. Addition of 10^{-6} or 10^{-5} adenosinetriphosphate (II) to the (I) usually caused dilation of the blood vessels, while 10^{-4} (II) caused a powerful contraction which lasted from a few minutes to half an hour. Lower concentrations often caused contraction when applied to dilated vessels. All concentrations of (II) which caused dilation (including high concentrations after recovery from contraction) produced vigorous rhythmic contractions of the blood vessels. The period was 1–2 minutes and the amplitude was sufficient to change the flow by 50 per cent. or more. A marked retention of (I) in the preparation was noted when 10^{-4} (II) was used, and a smaller retention when 10^{-5} (II) was used. Perfusion with continuously increasing concentrations of (II) produced no indication of habituation to the dilation caused by low concentrations, but temporarily diminished the contraction produced by high concentrations. The strong vasoconstriction produced by 10^{-7} acetylcholine was abolished by simultaneous or subsequent perfusion with (II) in concentrations of 10^{-6} to 10^{-4}.

M. E. DEUTSCH (Chem. Abstr.).

Acetylcholine and Neuronal Activity. I, Cholinesterase Patterns and Acetylcholine in the Cerebrospinal Fluids of Patients with Craniocerebral Trauma. Tower, Donald B., and McEachern, Donald. [*Can. J. Research*, **27**E, 105–19 (1949); *cf. C. A.*, **42**, 5940c.]

Cerebrospinal fluids from 112 neurological and neurosurgical patients were examined for acetylcholine (I), cholinesterase (II), and routine constituents. Except for epileptics, the only positive assays for (I) occurred in the cases of craniocerebral trauma (15) and of electric shock therapy (9), in which values of 0·2 to 100 g. per cent. were found. (II) in cases of trauma and shock showed reversals of the normal fraction patterns which consisted of reduction of specific and increase of unspecified (II) fractions, and a decrease of total (II) activity. The extent of deviation from normal of (I) and (II) levels paralleled the severity of cerebral damage. In the less severe cases and during recovery (I) and (II) levels returned toward normal.

II. Acetylcholine and Cholinesterase Activity in the Cerebrospinal Fluids of Patients with Epilepsy. [*Ibid.*, 120–31.]

Of 56 epileptics and 53 non-epileptic neurological and neurosurgical patients, acetylcholine (I) was present in the cerebrospinal fluids of 8 of the non-epileptics, 6 of whom suffered from craniocerebral trauma, and 44 of the epileptics. The presence of (I) in the cerebrospinal fluids of epileptics apparently was related to the frequency of seizures, the occurrence of seizures, and the extent of electroencephalographic abnormalities. There seemed to be no correlation between (I) and cholinesterase values, medications, thresholds of assay methods, and types of epilepsy (with the exception of focal seizures due to intracranial tumor). The presence of (I) in association with epileptic seizures might indicate that (I) was directly related to the occurrence of seizures, or might merely be a coincidental finding.

LA VERNE L. KIESSLING (Chem. Abstr.).

Pharmacodynamic Action of Acetylcholine. Barnes, T. Cunliffe, and Beutner, R. [*Nature*, **164**, 109–10 (1949).]

It has been suggested (I) that a precise fit between " the drug action and some macromolecule structure in the living cell is required if a high degree of activity is to be observed," and (2) that all drugs which possess parasympathetic stimulant action contain a ketone O group adjacent to an ether O linkage with a Me-substituted N at a distance of 2 saturated C atoms. Cholinergic drugs have outstanding phase-boundary potentials (I) at the interface between saline and lipoid (analogous to the surface of neurones). There is evidence that acetylcholine (II) produces a negative (I) calculated from the increase in condition of the oil, and the only substance in nerve capable of generating sufficient (I) to produce nerve impulse. Its electrogenic action on guaiacol is approximately three times greater than that of adenosine triphosphate, both 0·05 per cent. Constituents of nerve (Na, K, etc.) have lower (I) in artificial systems resembling conditions at neuronal surface. Unlike other nerve substances, one can measure the electrogenic effect of one part in several million of (II) on sensitized oil surface. When the electric charge density on the N atom of (II) falls too low the molecule becomes inactive (based upon the effect of ionic covalent resonance in the N – H bonds of NH_4 ion). Physiological effects of onium compounds run parallel with dipole moments and dissociation constant of corresponding acids if it is assumed that these factors determine the ionization in the lipoid phase of the living cell, and thereby generate the (I) (pharmacodynamic action). This negative electricity generated by the drug produces the physiological effect. Negatively charged drugs will alter autonomic functions in living organisms. Molecule alterations like substitution of Et for Me have marked effects on the (I) of drugs. The importance of cationic heads and 5-atom chains in the structure of drugs are nothing more than additional factors determining lipoid-solubility and degree of ionization in the oil. Neglecting the lipoid-solubility factor, it is suggested and imagined that nicotinic action requires a molecule with smaller cationic head than that giving muscarinic (III) action and that the nicotinic effect is produced by the onium moiety, while the oxygenated end is endowed with (III) properties (vasodilatation produced by the O - C - O group in (II) is analogous to the action of CO_2), but nicotine dissolves in triglyceride oils in which most cholinergic drugs are insoluble. It is assumed that the entire surface of a cellular membrane must be covered by a continuous layer of drug molecule. This area is not important under certain considerations. By employing a suitable model, it is shown that the potential measured between the inside and outside of a membrane is not determined by the surface area on each side. The mode of action of drugs which block adrenergic action (dibenamine) and cholinergic action (curare) appears to be a (I) based on differential solubility in oils. Curare produces almost the same extraordinary negativity as (II). It is assumed that some receptor cells contain a plethora of (II), and blocking agents like tri-Et (II) are imagined to reduce the large (inhibiting) concentration of (II) to a lower (stimulating) level. No electric evidence supports this hypothesis.

G. T. BOYKIN (Chem. Abstr.).

Action of Anticholinesterases, Drugs, and Intermediates on Respiration and Electrical Activity of the Isolated Frog Brain. Brooks, V. B., Ransmeier, R. E., and Gerard, R. W. [*Am. J. Physiol.*, **157**, 299–316 (1949) ; *cf. preceding abstract.*

The isolated frog brain (and nerve) was used to study the influence of a number of substances on function, indicated by normal caffeine-induced electric waves, and on metabolism, indicated by O consumption and cholinesterase activity. The fluoroacetates, inhibitors of carbohydrate metabolism, and the fluorophosphates, polyphosphate esters, eserine, and atropine, recognized as acting on the acetylcholine-cholinesterase system, affect function and metabolism in comparable ways, not in different ones. Eserine largely or fully protects brain and nerve from diisopropyl fluorophosphate (DFP) depression of both function and respiration. Atropine does not protect against tetraethylpyrophosphate (TEP) or DFP, nor is its own action prevented by them. Caffeine in small doses increases electric activity and O consumption, in larger doses it depresses both. Inhibitors combined with caffeine similarly increase or decrease function and respiration in parallel at appropriate concentrations. Fumarate protects against methylfluoroacetate action and it, with several other dicarboxylic acids at low concentration, initiates large convulsive potentials in the isolated brain. The results favor a significant role of the tricarboxylic cycle in brain metabolism, one related to the maintenance of function. DFP and TEP disturb function by mechanisms independent of the simple inhibition of cholinesterase. An interference with oxidative metabolism is indicated. E. D. WALTER (Chem. Abstr.).

Inhibition of Brain Dehydrogenases by Anticholinesterases. Michaelis, M., Arango, N. I., and Gerard, R. W. [*Am. J. Physiol.*, **157**, 463–7 (1949).]

The dehydrogenase activity of brain and nerve was studied with the methylene blue technique. Age had little influence on brain dehydrogenases ; freezing decreased activity to about 1/5. Nerve dehydrogenase was about 1/10 as active as brain dehydrogenase. The anticholinesterase drugs, diisopropylfluorophosphate, tetraethylpyrophosphate and eserine sulfate are inhibitors of brain and nerve dehydrogenases, the 2 former being in general even more powerful than the metabolic inhibitor, methyl fluoroacetate. Dehydrogenase inhibition is specific in pattern for each drug ; even at 10^{-4} M drug concentration the oxidation of particular substrates may be inhibited by 10 to 25 per cent.

E. D. WALTER (Chem. Abstr.).

The Cholinesterase of the Elephant Brain. Zeller, E. A. [*Helm. Chim. Acta*, **32**, 484–8 (1949) (*in German*).]

Elephant brain contains less e-type cholinesterase than any mammal brain so far investigated. This is consistent with the general tendency for different species of mammals to show a decrease of brain cholinesterase with an increase in brain weight. KARL F. URBACH (Chem. Abstr.).

The Content and Characterization of Cholinesterases in Human Cerebrospinal Fluids. Tower, Donald B., and McEachern, Donald. [*Can. J. Research*, **27E**, 132–45 (1949).]

Cerebrospinal fluids (I) of 104 neurological and neurosurgical patients were analyzed. Cholinesterase determinations were made by a modified Warburg method and the fractions characterized by using mecholyl and benzoylcholine as substrates. The average rate of acetylcholine hydrolysis of (I) was approximately 0·5 per cent. of the cholinesterase activity of an equal volume of blood or serum. Human spinal fluid contained specific cholinesterases with a small component of unspecified cholinesterases. The subdural fluids resembled blood serum in their fraction patterns, but activity was about 2 per cent. that of the serum. No correlation of cholinesterase values with (I) cell counts was found. Samples with positive Pandy tests and very high protein levels showed a tendency toward decrease in specific and increase in unspecified cholinesterases; attempts to correlate other (I) cholinesterase values with Pandy tests and protein levels were inconclusive. No correlation of (I) cholinesterase values with clinical diagnosis was found except in cases of cranio-cerebral trauma and cases treated by electric shock therapy. At acetylcholine substrate concentrations in the physiological range of 0·01 to 10·0γ per cent., (I) cholinesterase activities were markedly reduced or absent.

La Verne L. Kiessling (Chem. Abstr.).

Influence of Various Vitamins on the Nervous Effects of Adrenaline, Acetylcholine, Choline and Adrenochrome. Chauchard, Paul, Mazoue, Henriette, and Lecoq, Raoul. [*Compt. rend. soc. biol.*, **142**, 1346–9 (1948); *cf. C. A.*, **43**, 284*b*, 1107*h*, 3901*h*.]

In rats repeated administration of adrenaline increases nerve chronaxia. This effect is neutralized by thiamine and possibly to a slight extent by vitamins A, B_6, E, K, and folic acid, but not by inositol, biotin and vitamin D. Riboflavin, nicotinamide, adenine, pantothenic acid and vitamin P may increase the effect of adrenaline. Acetylcholine decreases nerve chronaxia. A return to normal is obtained with biotin, inositol, and vitamins C, D and P, but not with vitamins A, B_1, B_2, B_6, E, F (linoleic acid), K, P, nicotinamide, adenine and pantothenic and folic acids. The action of choline on the nervous system is prevented by all of the above vitamins except C, D, F and biotin. The effect of adrenochrome (decrease in chronaxia) is neutralized by vitamins A, B_1, B_2, E, K, and folic acid; and reversed with increase of chronaxia to above normal by vitamins B_6 and P. Choline antagonizes the effects of adrenaline and adrenochrome but not the effect of acetylcholine.

L. E. Gilson (Chem. Abstr.).

Motor Disorders in Rats on Amino Acid (Valine) Deficient Diet. Ferraro, A., and Roizin, L. [*Trans. Am. Neurol. Assoc.*, **71**, 131–2 (1946).]

Rats maintained 4–14 weeks on diets deficient in valine showed deficient growth, weight loss, change of general aspect of fur, hunched posture, corneal dystrophy, marked irritability, easy fatiguability in walking, uncertainty of gait, and loss of equilibrium. These disorders were corrected within 3–5 weeks by adding synthetic valine to the diet.

Marion Horn Peskin (Chem. Abstr.).

The Neuropathology of Thiamine Deficiency in the Rhesus Monkey, with Observations on the Frequent Occurrence of Degeneration in the Basal Ganglion. Rineheart, J. F., Friedman, M., and Greenberg, L. D. [*Trans. Am. Neurol. Assoc.*, **71**, 174–6 (1946).]

Seven rhesus monkeys with severe thiamine deficiency showed degenerative lesions of the central gray matter of the nervous system. The most striking and frequent changes were in the putamen and caudate nuclei. The observations suggest that thiamine deficiency might contribute to the production of Parkinson's disease, hepatolenticular degeneration, and other selective degenerations of basal ganglia.

Marion Horn Peskin (Chem. Abstr.).

Distribution of Thiamine in the Brain. Villela, Gilberto Guimarães, Dias, Mario Vianna, and Queiroga, Laura T. [*Arch. Biochem.*, **23**, 81–4 (1949).]

Microbiological estimations of thiamine showed average values of 1·8 ± 0·48 for the cortex, 1·2 ± 0·37 for the white matter, and 2·0 ± 0·53γ/g. tissue for the nucleus caudatus of the brains of 17 normal dogs. Following injection of large doses of thiamine, average values were respectively 2·7 ± 0·32, 2·1 ± 0·62, and 3·4 ± 0·62γ/g. tissue. Comparable values were obtained whether 1 mg./kg. body weight/day was injected for from 10 to 21 days or 10 mg./kg. body weight/day for 8 days. MARSHALL E. DEUTSCH (Chem. Abstr.).

Psychological Effects of Levels of Vitamin B_1 and Glutamic Acid in the Diet. Aschkenasy-Lelu, Paule. [*Ann. nutrition et aliment.*, **3**, 109–44 (1949).]

J. DUFRENOY (Chem. Abstr.).

Alcoholism and B_1 Vitamin Deficiency. Goth, Endre and Simon, Tibor. [*Orvosok Lapja*, **4**, 682–3 (1948) ; *cf. C. A.*, **40**, 7335⁴.]

Polyneuritis is often a symptom of chronic alcohol intoxication ; probably vitamin deficiency may also play a role. In clinical load tests often severe vitamin B_1 deficiencies were observed without any signs of neuritis. Clinical experiments were conducted with vitamin B_1 loads on alcoholic persons. Also the amounts of substances binding bisulfites were determined according to the method of Clift and Cook as modified by Laszt. Most alcoholic persons showed vitamin deficiency ; the excretion of vitamin B_1 during the load test was, on an average, 10·3 per cent. as against 21·1 per cent. for persons saturated with vitamin. Simultaneously the amount of bisulfite-binding material increased significantly ; it showed a mean value of 11·4 mg. per cent. against 8·2 mg. per cent. for saturated persons. Nine persons out of 12 belonged to the first group, proving that not only vitamin B_1 deficiency but also the toxic effect of alcohol plays a role in the etiology of alcoholic polyneuritis. ISTVÁN FINÁLY (Chem. Abstr.).

Relation of Blood and Cerebrospinal Glucose. Vuylsteke, Ch. A. [*Arch. intern. pharmacodynamie*, **78**, 456–60 (1949).]

Variations in the amount of glucose in ventricular perfusion fluid administered to dogs does not affect the blood-sugar level.

M. L. C. BERNHEIM (Chem. Abstr.).

Quantitative Spinal Fluid Glucose Micro Method for the Pediatric Ward Laboratory. Gardner, Lytt I., Berman, Helen, McLachlan, Elsie A., and Terry, Mary L. [*J. Lab. Clin. Med.*, **34**, 725–7 (1949).]

0·25 ml. of spinal fluid is used for the determination of glucose by the picric acid method of Lewis and Benedict (*cf. C. A.*, **9**, 638) with an accuracy of ±3·5 per cent. BERNARD KLEIN (Chem. Abstr.).

Spectrophotometric Investigation of the Normal Human Cerebrospinal Fluid. De-Lerma, B., and Salvi, P. [*Acta Neurol.* (*Naples*). **4**, 74–7 (1949).]

The spectrum of the fluorescence of the human cerebrospinal fluid (I) gave a maximum emission near 4660A ; the fluorescence was found to fade after (I) irradiation with ultraviolet rays. The substance which gives the fluorescence is thought to have a pterinic ring and probably to be the xanthopterin of Wieland and Purrmann (*C. A.*, **35**, 123¹). C. SCANDURA (Chem. Abstr.).

Specificity of the Tributyrinase of the Cerebrospinal Fluid. Salvi, P., and Giordano, G. G. [*Acta Neurol.* (*Naples*), **4**, 49–55 (1949).]

The tributyrinase activity (I) of cerebrospinal fluid was investigated as a function of the pH, the $CaCl_2$ concentration, the NaF concentration, the quinine hydrochloride (II) concentration and the Na taurocholate (III) concentration. The optimum pH for (I) was 7·5 ; optimum concentrations of $CaCl_2$ and NaF (or (II) or (III)) activate and inhibit (I). This behavior is compared with that of (I) in blood.

C. SCANDURA (Chem. Abstr.).

Cerebrospinal Fluid. I, *The Cerebrospinal Fluid-Blood Sugar Relationship in Normal Children and Children with Tuberculous Meningitis. Kirchmair, Heinrich.* [*Z. Kinderheilk.*, **66**, 274–82 (1949).]

Fasting blood (I) and cerebrospinal (II) sugar determinations on 63 healthy and 52 meningitic (tuberculous) children of the ages of 1 to 10 years are reported. In the healthy group (II) sugar values from 34·6 to 85·4 mg. per cent. and (I) sugar values from 56·5 to 137·4 mg. per cent. were observed. (II) sugar values were 45–70 mg. per cent. in 80·9 per cent. of all healthy cases, and (I) sugar values were 60–120 mg. per cent. in 90·4 per cent. of the cases of this group. The mean (II) sugar level of the healthy child was found to be 62·1 per cent. of the simultaneously determined (I) sugar level. In cases of tuberculous meningitis (II) sugar values were 10·2–31·4 mg. per cent., as compared with 54·6–158·3 mg. per cent. for simultaneously determined (I) sugar values. In 82·7 per cent. of these cases the (II) sugar values were 15–30 mg. per cent. ; whereas 72·5 per cent. of the (I) sugar values were 60–120 mg. per cent. Thus, in tuberculous meningitis the mean (II) sugar values were 22·1 per cent. of the simultaneously determined (I) sugar values. The linear relationship which exists in healthy children does not hold in cases of tuberculous meningitis. KURT I. ALTMAN (Chem. Abstr.).

Proteins in the Colloidal Gold Reaction. Bernsohn, Joseph, and Borman, Karl K. [*J. Clin. Invest.*, **26**, 1026–30 (1947).]

Gamma-globulin has a coagulatory action on colloidal Au. One or more β-globulins and possibly α-globulin are responsible for the protective action of normal body fluids, as distinct from the serum albumin which is inert. Gamma-globulin might be used to determine whether 2 batches of Au sol are comparable. Conversely, a stardandized Au sol may be useful in the analysis of blood fractions.

JOHN T. MYERS (Chem. Abstr.).

The Passage of Sulfones through the Blood-spinal Fluid Barrier. Trabucchi, Cherubino. [*Atti soc. med.-chir. Padova*, **23**, 23 pp. (1945).]

The blood level of the diglucoside of 4·4′-diaminodiphenyl sulfone was followed for 10 hours after the intravenous injection of 40 mg. per kg. The glucoside easily undergoes hydrolysis liberating 2 amino groups which can be acetylated. The aqueous solution of the sulfone easily passes through cellophane. The ultrafiltrate of serum, however, contains only about 60 per cent. of that of the filtered serum, which proves that the sulfone circulates bound to non-filtrable constituents. In contrast to other sulfonamides, the glucoside passes the spinal-fluid barrier only at extreme concentrations in the blood. The permeability is higher in cases of meningitis. The sulfone arrives in the spinal fluid with partially free amino groups. It is necessary to give the substance by spinal injection to assure a sufficient concentration in cases of meningitis. The presence of appreciable quantities of sulfone in the spinal fluid after intravenous application may serve as a test for the integrity of the spinal barrier. A. E. MEYER (Chem. Abstr.).

A New and Simple Method for the Separate Determination of Very Small Amounts of Free and Esterified Cholesterol in Cerebrospinal Fluid in Different Nervous and Mental Diseases. Selbach, Helmut, and Trappe, Wolfgang. [*Arch. Psychiat. Nervenheilk.*, **117**, 541–54 (1944).]

The method of Trappe (*C. A.*, **37**, 3119^9) was modified for application to cerebrospinal fluid (C.S.F.). Cholesterol (I) is absorbed from diluted C.S.F. on special silicic acid hydrate and separated into combined and free fractions by chromatography on Al_2O_3. Benzene is used to elute the combined and Et_2O :—$CHCl_3$ (2 : 1) the free (I). Combined, free and total (I) were determined in C.S.F. from 53 patients with a variety of nervous and mental diseases. The total (I) varied from 0·01 to 2·4 mg./100 ml. with most of the values between about 0·2 and 0·4 mg. In most cases the combined comprised about 40 to 60 per cent. of the total (I).

WARREN M. SPERRY (Chem. Abstr.).

The Presence and Importance of Iron in the Cerebrospinal Fluid. Tramontana, Corrado. [*Boll. soc. ital. biol. sper.*, **24**, 615–17 (1948).]

The Fe content of the cerebrospinal fluid of 10 men and 10 women between 17 and 66 years old varied from 23 to 52 (average 35) γ per cent. There was no difference in the Fe level of the 2 sexes. The interpretation of the findings is discussed. F. FROMM (Chem. Abstr.).

Formation, Diffusion and Absorption of Cerebrospinal Fluid. (I) Preliminary Studies on Sodium.^{24}. *Sweet, W. H., Solomon, A., and Selverstone, B.* [*Trans. Am. Neurol. Assoc.*, **73**, 228–30 (1948).]

After intravenous injection of 0·8 millicurie of Na^{24} ions per 50 kg. body weight, the concentration of Na^{24} in the blood promptly reached a peak, then fell sharply during the first hour. Concentration of Na^{24} in the cerebrospinal fluid of 6 patients was greater in the ventricles than in the cistern, and least in the lumbar region. Variations seen in patients with various brain diseases are described.

MARION HORN PESKIN (Chem. Abstr.).

Immunochemical Estimation of Albumin and γ-globulin in Normal and Pathological Cerebrospinal Fluid. Kabat, Elvin A., Glusman, Murray, and Knaub, Vesta. [*Trans. Am. Neurol. Assoc.*, **73**, 93–4 (1948).]

Titered rabbit antiserums to crystallized human serum albumin and to purified γ-globulin were absorbed with heterologous antigen. After 1 hour at 37° and 48 hours in the refrigerator, the precipitants were centrifuged off, washed twice in the cold with saline, and analyzed for N. Total N precipitated was plotted against quantity of antigen added. The albumin and γ-globulin in cerebrospinal fluid were determined by adding a dilution of cerebrospinal fluid to the antiserums, and measuring the total N in the washed precipitants. In 10 healthy individuals the values for albumin and globulin were 11–19 and 1·7–3·8 mg./100 ml. respectively. Marked increases in γ-globulin occurred in 15 of 16 patients with neurosyphilis, and in 8 of 14 with multiple sclerosis. MARION HORN PESKIN (Chem. Abstr.).

The Pathological Physiology of Cerebrospinal Fluid. (I) Electrophoretic Separation of the Proteins of the Cerebrospinal Fluid in Inflammatory diseases of the Nervous System; a Contribution to the Pathological Physiology of Meningeal and Cerebral Blood Vessels. Scheid, K. F., and Scheid, L. [*Arch. Psychiat. Nervenkrankh.*, **117**, 219–50 (1944); *cf. C. A.*, **43**, 3876*f*.]

Cerebrospinal fluid (C.S.F.) was dialyzed (*cf.* following abstract for 48 hours at 1–4° against a buffer at about pH 8). Total protein (I) was determined in the dialyzed C.S.F. by the interferometer. So prepared C.S.F. from patients with inflammatory diseases of the nervous system was subjected to electrophoresis in the Tiselius apparatus. The patterns were interpreted by comparison with electrophoretic patterns (reported in detail) of blood serums. Albumin (II) and α-, β-, and γ-globulin (III) were identified in most of the C.S.F.'s. The increased (I) in C.S.F. in these diseases comes from the blood serum. In polyneuritis, poliomyelitis and meningitis (II) was present in the largest quantity, but in paralysis frequently γ-(III) was the major or only (I) shown in the electrophoresis. The mechanism of the hematoencephalic barrier (IV) action is discussed as a chemical process. Increased permeability of (IV) to (I) may arise from the rupture of chemical bonds with formation of larger openings in the membrane, but the preferential passage of high-molecule weight (III) is difficult to explain on chemical theory.

(II) The Separation of Small from Large Molecules in Cerebrospinal Fluid by Microdialysis. [*Ibid.*, 312–25.]

A method for dialysis of small amounts of C.S.F. is given with detailed description of apparatus. At least 24 hours and preferably 48 hours are necessary to remove all low-molecule weight substances. Reactions for syphilis were usually somewhat decreased in dialyzed C.S.F. The ultraviolet absorption of C.S.F. was changed markedly by dialysis; a characteristic (I) curve with a band at 2800 A. was found in dialyzed C.S.F. and there was a fairly close relation between (I) concentration and extinction at 2800 A.

(III) An Electrophoretic Investigation of the Proteins of the Cerebrospinal Fluid in Patients with Tumours of the Central Nervous System. [*Ibid.*, 641–66.]

The small amounts of C.S.F. and low (I) concentration necessitated a special technique (described in detail) for electrophoresis. Ultrafiltrates of C.S.F. were used. In only 22 of several hundred patients with brain tumors was enough C.S.F. with sufficiently high (I) concentration obtained to be studied. In most of these the high-molecule weight substances showed the electrochemical properties of serum (I) (II and α-, β-, and γ-(III)). In 1 patient evidence was obtained for the presence in C.S.F. of a substance not identical with any serum (I). In 9 cases the (II) : (III) ratio was also determined by $(NH_4)_2SO_4$ precipitation ; the results were in wide disagreement in most cases with those obtained by electrophoresis.

WARREN M. SPERRY (Chem. Abstr.).

Blood and Spinal Fluid Guanidine in Epilepsy. Elliott, K. A. C., and Henderson, Nora. [*Can. J. Research*, **27**E, 211–13 (1949).]

The blood guanidine (I) levels of 25 patients in epileptic conditions were determined and lay in the range 0·19–0·16 mg. (I) per 100 ml. (I) levels in the spinal fluid of 6 patients ranged from 0·10 to 0·17 mg./100 ml. There was no sign of raised (I) levels in blood or spinal fluid of any type of epileptic patient.

BERNARD WOLNAK (Chem. Abstr.).

Studies on the role of the Cerebrospinal Fluid in Brain Metabolism as Measured with Radioactive Phosphate. Bakay, L., and Lindberg, Olov. [*Acta Physiol. Scand.*, **17**, 179–90 (1949).]

When P^{32} is injected into the cisterna magna of rabbits, the radioactivity in different parts of the brain increases gradually and quite uniformly reaching a maximum in 35 minutes. The nervous tissue exchanges P by way of the cerebrospinal fluid while glandular parts (pituitary, pineal body), choroid plexus and the vegetative centers in hypothalamus obtain this through the blood.

S. MORGULIS (Chem. Abstr.).

Nitrogen Trichloride and Canine Hysteria. Moran, T. [*Lancet*, **253**, 289–91 (1947).]

Canine hysteria was produced within 24 hours by the use of NCl_3 in amounts which were considerably in excess of those used in milling practice. NCl_3 reacts with wheat protein, casein, zein, and gelatin, producing substances which cause canine hysteria. The symptoms rapidly disappear when the dogs are given the same diet untreated with NCl_3. The production of these substances appears to involve a particular structure in the protein molecule which does not include lysine, tryptophan or glycine. B. A. (Chem. Abstr.).

Lysozyme in Nervous Tissue. Tolone, Salvatore. [*Boll. soc. ital. biol. sper.*, **24**, 692–3 (1948).]

Presence of lysozyme activity against *Micrococcus lysodeikticus* in nervous tissue could not be shown. Only dilute acetone extracts could be studied because of incomplete extraction of fats. Clearer fractions were obtained with petroleum ether, and when these were added to saline containing purified lysozyme from egg albumin, there was no increase or decrease of lytic activity.

M. ELLIOTT (Chem. Abstr.).

The Action of Metabolites and Synthetic Hormones of the Thyroid on Vegetative Centers. Kassil, G. N., and Plotitsyna, T. G. [*Fiziol. Zhur. S.S.S.R.* (*J. Physiol.*), **32**, 681–94 (1946).]

Suboccipital injection of cat thyroid extracts (2–6 mg. per cent. of (I) content in the extracts prepared from 0·3 g. tissue per 10 ml. Ringer solution dosage 0·05–1·0 ml.) into dogs has a profound effect on the spinal fluid. The protective and regulatory function of hemato-encephalic barrier is disrupted, general repression of the nervous system takes place, and the tone of parasympathetic centers rises. The changes persist for prolonged periods. The stimulating effect on gas metabolism is more readily produced with suboccipital injections than with intravenous.

Transplant of thyroid into the brain tissue has an effect which is similar to injections of thyroxine. Reducing substances in the blood and spinal fluid decline, as does the sugar level; muscle glycogen rises, glycemic loading curve drops, acetylcholine-like substances in the spinal fluid rise as do Ca and Ca/P, while pH, K and P levels decline. G. M. Kosolapoff (Chem. Abstr.).

The "Action Substance" of the Sensible Nerves. Hellauer, H. F., and Umrath, Karl. [Arch. ges. Physiol. (Pflugers), **249**, 619–30 (1948).]

A substance can be extracted from the dorsal roots of the spine which, if injected subcutaneously, can be detected by the blushing of denerved rabbit ears. This substance is not identical with either acetylcholine or histamine. It is destroyed by an enzyme which also is present in the dorsal roots of the spine. This enzyme is inhibited by strychnine but is active in the presence of eserine. The active substance is isolated as follows: a weighted amount of the dorsal root is extracted with 3 times its weight of a solution of 0·65 per cent. NaCl and 0·01 per cent. $CaCl_2$,, and heated for 1 minute. This procedure is repeated a few times, and the extracts are combined. This extract is mixed with 50 volumes of concentrated NaOH, concentrated *in vacuo* by evaporation, and the residue extracted with 96 per cent. EtOH. The EtOH solution is concentrated, the residue extracted with $CHCl_3$, and the $CHCl_3$ removed. Six mg. dry residue was obtained for 1 g. of nerve. (Gertrude E. Perlmann Chem. Abstr.).

The Exchange of Lactic Acid between Arterial Blood and Brain Tissue and Changes in the Lack of Oxygen. Loeschcke, Gertrud and Loeschcke, Hans H. [Arch. ges. Physiol. (Pflugers), **249**, 521–38 (1948).]

If only slight anesthesia is applied to dogs, lactic acid is readily exchanged between blood and brain tissue. During periodic respiration the rate of exchange varies. During lack of O. the exchange takes place likewise, but is followed by an accumulation of lactic acid in the brain tissue. Gertrude E. Perlmann (Chem. Abstr.).

Influence of the Central Nervous System on the Glycemic Reaction with Work. Vogel, Gunther. [Z. ges. inn. Med., **4**, 101–10 (1949).]

Aspirin and phenobarbital given to male and female students had no influence on the glycemic reaction when given with or after a measured amount of work. No proof of participation of the brain stem centers on blood-sugar regulation was found. J. D. Taylor (Chem. Abstr.).

Changes in the Nitrogen Metabolism in the Brain in Some Pathological Processes. Promyslov, M. Sh. [Doklady Akad. Nauk S.S.S.R., **66**, 667–9 (1949).]

In normal rabbits the ratio of residual N to total is quite constant (8·3–8·5 per cent.). In diphtheria it rises to 11–16 per cent., although the ratio of total N to dry brain matter is unchanged (about 6·5 per cent.). Tying a vein for 24 hours does not change the values. G. M. Kosolapoff (Chem. Abstr.).

Histamine and its Antagonists on Chronaxia and its Application to Anaphylactic Shock. Chauchard, Paul. [Arch. intern. Pharmacodynamie, **79**, 139–54 (1949); *cf. C. A.*, **43**, 2696*g*.]

Histamine depresses the excitability of central neurones and preganglionic sympathetic fibers, but increases that of the postganglionic sympathetics. Antergan counteracts these effects. Chronic histamine poisoning increases the chronaxia of the nervous system, as does latent anaphylactic shock. M. L. C. Bernheim (Chem. Abstr.).

The Central Action of Parpanit. Daeninck, L., and Libbrecht, L. [Arch. intern. pharmacodynamie, **79**, 263–8 (1949).]

Intralobular or intracisternal injection of parpanit (0·5 mg./kg.) into dogs depresses and then stimulates respiration, raises the blood pressure, and abolishes the patellar reflex for a long time. Intravenous or intra-arterial injection of 5 times the dose has no such effect. M. L. C. Bernheim (Chem. Abstr.).

Proprioception and Convulsions. *Gellhorn, E., Hyde, J., and Gay, J.* [*Arch. intern. pharmacodynamie*, **80**, 110–18 (1949).]

Topical application of strychnine to the motor cortex of cats and monkeys showed that after-discharges were primarily dependent on proprioceptive impulses coming from the muscles. M. L. C. Bernheim (Chem. Abstr.).

The Effect of NU 683 on Salivary Secretion. *Fernandez, A., and Vinoles, J. J.* [*Arch. intern. Pharmacodynamie*, **80**, 85–8 (1949).]

Doses of NU 683 which inhibit the pseudocholinesterases sensitize the salivary glands to acetylcholine but not to chorda tympani stimulation.

M. L. C. Bernheim (Chem. Abstr.).

The Effect of NU 683 on the Respiratory Reflexes from the Carotid Body. *Fernandez, A.* [*Arch. intern. Pharmacodynamie*, **80**, 82–4 (1949).]

Doses of NU 683 which inhibit the pseudocholinesterases sensitize the carotid body to acetylcholine but not to Na_2S. M. L. C. Bernheim (Chem. Abstr.).

Uptake of Radioactive Phosphorus by Malignant Brain Tumors. *Erickson, Theodore C., Larson, Frank, and Gordon, Edgar S.* [*J. Lab. Clin. Med.*, **34**, 587–91 (1949).]

P^{32} (I) was administered parenterally to patients with malignant intracranial tumors, e.g. glioblastoma multiforme, craniopharyngioma, oligodendroglioma, meningioma. Biopsy material showed the ratio of concentrations of radioactivity in tumor and normal brain tissue to rise to as high as 19 : 1. Chemical fractionation of tissue (I), into acid-soluble (I), alcohol soluble (I), ribonucleic acid (I), and desoxyribonucleic acid (I) showed small but significant concentration of radioactivity in both cytoplasm and nucleus. Bernard Klein (Chem. Abstr.).

Brain and Plasma Cations and Experimental Seizures in Normal and Desoxycorticosterone-treated Rats. *Woodbury, Dixon M., and Davenport, Virginia D.* [*Am. J. Physiol.*, **157**, 234–40 (1949).]

Normal rats treated with desoxycorticosterone acetate (DCA) or injected with isotonic NaCl or $CaCl_2$ solution have elevated electroshock thresholds. Rats injected with isotonic KCl or $MgCl_2$ solution or phosphate buffer show lowered thresholds for electroshock convulsions. The injection of Ringer solution produces no change in electroshock seizure threshold. The brains of rats treated for 23 to 31 days with DCA contain normal concentrations of water, Na, K and Cl. This is apparently also true of the brains of rats injected with NaCl, KCl, $CaCl_2$, or $MgCl_2$ solutions. The changes in brain excitability produced by treatment with DCA or the 4 salt solutions can be correlated with changes in plasma Na or Ca concentrations. An increase in plasma Ca, if not masked by a change in plasma Na, is accompanied by an elevation of the electroshock threshold. Any change of more than 3 milliequivalents per (I) in plasma Na is accompanied by a change of electroshock seizure threshold in the same direction.

E. D. Walter (Chem. Abstr.).

Comparison of Respiration and Glycolysis in the Brains of Normal and Febrile Rabbits. *Peiss, C. N., Field, J., Hall, V. E., and Goldsmith, M.* [*Am. J. Physiol.*, **157**, 283–6 (1949).]

The mean Q_{O_2} values (microscopical of O consumed) at 39° for cerebral cortex slices from normal rabbits and from rabbits with fever produced by administration of typhoid-paratyphoid vaccine were 8·76 and 8·58 respectively. The mean Q_{NA_2} values (microscopical of acid produced, measures as a gas under standard conditions per mg. initial dry weight of tissue per hour) at 39° for cerebral cortex from normal and febrile rabbits were 12·58 and 12·27 respectively. An hypothesis relating the level at which body temperature is regulated to the metabolic activity of the central nervous system is stated and the bearing of these findings on that hypothesis is discussed. E. D. Walter (Chem. Abstr.).

Inhibition of Acid Phosphatases of Sheep Brain. Mattocks, Albert M., and Holtan, Sally D. [*J. Pharmacol. Exptl. Therap.*, **96**, 114–18 (1949).]

Structural similarity between glycerophosphorylcholine and certain drugs known to act on the nervous system suggested possible competitive action, and a number of such compounds were tested for effect on the hydrolysis of β-glycerophosphate and phosphorylcholine at pH 5·0. Sulfate, pyrophosphate and diisopropylfluorophosphate inhibited acid glycerophosphatase competitively; their Ki values were between 0·001 and 0·0001. Fluoride inhibited non-competitively. Cyanide, iodoacetate, alanine, glutamic acid, *p*-amino-benzoic acid, creatine, cystine, cysteine, glutathione, ascorbic acid, acetylcholine, carbamyl-choline, Me_4NBr, choline, urethane, tetraethyl, pyrophosphate triethyl phosphate, tri-o-cresyl phosphate, myanesin, procaine, sulfanilamide and pilocarpine had no significant effect on the acid phosphatases. L. E. Gilson (Chem. Abstr.).

Phosphorylation of Hexoses by Brain Hexokinase. Wiebelhaus, Virgil D., and Lardy, Henry A. [*Arch. Biochem.*, **21**, 321–9 (1949).]

A description is given of the preparation of a stable beef brain powder, low in electrolytes, and with good hexokinase and phosphohexokinase activity. This phosphorylated glucose, fructose, mannose and glucose-, fructose-, and mannose-6-phosphates, but not galactose, ribose, gluconic acid nor a number of other sugars. With 0·002 M adenosine triphosphate present beef brain hexokinase has a very high affinity for glucose but much less for fructose. Na salts inhibit the phosphorylation of glucose, but not of fructose or fructose 6-phosphate. Factors affecting differences in the rates of tissue glycolysis and oxidation of glucose and fructose are discussed. Winifred M. Bridges (Chem. Abstr.).

Chemical Studies of the Brain in Dogs with "Running Fits." Gershoff, S. N., Newell, G. W., and Stone, W. E. [*Arch. Biochem.*, **21**, 74–6 (1949).]

Cerebral glucose, glycogen, lactic acid, acid-soluble P, fraction precipitated and fraction not precipitated by $Ca(OH)_2$ were all normal in dogs with running fits. It is unlikely that there is a chronic disturbance in the cerebral oxidative mechanism, or P mechanism. John T. Myers (Chem. Abstr.).

Effect of Local Anesthetics on the Respiration of Brain Homogenates. Watts, Daniel T. [*J. Pharmacol. Exptl. Therap.*, **96**, 325–31 (1949).]

Cocaine, procaine, metycaine, tetracaine and nupercaine inhibit the oxidation of glucose, succinate and ascorbate, but do not inhibit the anaerobic glycolysis of glucose by brain homogenates. The oxidation and reduction of cytochrome c is inhibited; the anaerobic reduction of methylene blue in presence of succinate and homogenate is not inhibited. These results indicate blocking of the enzymic chain at the cytochrome c-cytochrome oxidase level or at some factor necessary for the reduction of cytochrome c. There is a wide range in the degree of inhibition by the different anesthetics at a given concentration. The inhibiting potency increases in approximately the above order of naming, which is the order of increasing anesthetic potency *in vivo*. L. E. Gilson (Chem. Abstr.).

Circulatory Changes and Pulmonary Lesions in Dogs following Increased Intracranial Pressure, and the Effects of Atropine on such Changes. Campbell, Gilbert S., Haddy, Francis J., Adams, Wayne L., and Visscher, M. B. [*Am. J. Physiol.*, **158**, 96–102 (1949).]

Elevation of the intracranial pressure in anesthetized dogs was followed by bradycardia, lowered cardiac output and increased mean pulmonary venous and arterial pressures. When the pulmonary venous pressure rose above 20 mm. Hg. significant degrees of pulmonary edema, congestion and hemorrhage were seen at necropsy. Administration of atropine after induction of the changes listed above as following maintained elevation of the intracranial pressure reversed those changes, and significant pulmonary edema did not occur.

E. D. Walter (Chem. Abstr.).

Protection of Glycolysis in Mouse Brain Homogenates by Amides and Esters of Amino Acids. Krimsky, I., and Racker, E. [*J. Biol. Chem.*, **179**, 903–14 (1949).]

The glycolytic activity of mouse brain homogenates is inhibited by a factor obtained by homogenizing normal mouse brains in 10 vols. 0·01 M K_2HPO_4-KH_2PO_4 buffer of pH 7·4 at 0°, centrifuging, and washing the particles twice with the same buffer in the cold. This factor requires Fe++ and either cysteine or ascorbic acid as activators. The inhibition of glycolysis resulting from addition of $FeSO_4$ to normal brain homogenate is diminished strongly by glutathione and N-phenylglycine ethyl ester; moderately by L-leucinamide and the Et esters of L-leucine, L-valine, L-glycine, L-glycylglycine, and L-cysteine; weakly by benzoylargininamide and malonamide; and not all by L-glycylglycine, L-leucylglycine, L-glycylleucine, L-glycylserine, L-glycylasparagine, L-leucylglycylglycylglycine, L-alanylglycine, urea, L-glycylleucinamide or carbobenzoxyglycylleucinamide. A similar but less pronounced protection of glycolysis was obtained in brain homogenates of mice infected with Theiler FA mouse encephalomyelitis virus and normal brain homogenate was protected from inhibition due to cathepsin III (I) by addition of L-leucine ethyl ester (II). Both (I) and brain homogenate hydrolyzed (II) and L-cysteine ethyl ester.

MARSHALL E. DEUTSCH (Chem. Abstr.).

The Influence of Neurohormones on Unimolecular Films of Lecithin. Asperen, K. van. [*Chem. Weekblad.*, **45**, 374–7 (1949).]

Sjolin's technique (*C. A.*, **37**, 4950^8) was used to study the interfacial tension in a benzene-H_2O interface. The measurements were carried out with a torsion balance and a Pt ring 3·88 mm. in diameter. In the vessel was 400 ml. double distilled H_2O covered with a 1–2 cm. thick layer of pure benzene. The total surface area was 191 cm.^{2} Lecithin dissolved in 60 per cent. iso-PrOH was added to the interface with a 50 mm^3. microburet. Increased concentration of acetylcholine (I) in the aqueous phase decreased interfacial tension with a maximum effect at 0·0176 M (I). Adrenaline-HCl in the aqueous phase decreased the interfacial tension; ephedrine base showed less effect; $CaCl_2$ caused a very small lowering. That the activity of (I) was not caused by the quaternary ammonium group was shown with Me_4NI which showed only a small effect in the same concentration as (I). B. PRYTZ (Chem. Abstr.).

Studies on the Depression of Brain Oxidations. I, Biopsy Technique and Analysis of Variance in the Selection of a Pentobarbital Concentration. Wilkins, D. S., Featherstone, R. M., Gray, C. E., Schwidde, J. T., and Brotman, M. [*J. Lab. Clin. Med.*, **34**, 846–57 (1949).]

A detailed statistical method appropriate for small samples was combined with the standard manometric technique in selecting a Na pentobarbital (I) concentration, satisfactory for O consumption at various drug levels. The biopsy procedure allows the dog brain to serve as its own control for either *in vitro* or *in vivo* administration of drugs. A level of 0·04 per cent. (I) partially inhibited O consumption of dog cortex while that of 0·8 and 0·12 per cent. (I) inhibited it completely.

J. D. TAYLOR (Chem. Abstr.).

Pituitary and Carbohydrate Metabolism of the Brain. Reiss, M., and Rees, D. S. [*Endocrinology*, **41**, 437–40 (1947).]

The hexokinase activity of the gray matter of the rat brain increased markedly after either hypophysectomy or adrenalectomy. The anaerobic glycolysis of the gray matter increased after hypophysectomy and could be reduced to normal by treating the rats with adrenocorticotropic hormone.

L. E. GILSON (Chem. Abstr.).

Action of Condensed Alkyl Phosphates on the Nerve Muscle Preparation and the Central Nervous System of the Cat. Chennels, M., Floyd, W. F., and Wright, S. [*J. Physiol.* (*London*), (**108**) 357–97 (1949).]

Hexaethyltetraphosphate (HETP) and tetraethylpyrophosphate (TEPP) in amounts of 1–5 mg. were injected intravenously into chloralose-anesthetized (dose

0·08 g./kg. body wt.) or decerebrate cats, to study their effects on nerve-muscle action and certain reflexes. Injections were made into the central end of the jugular, inferior mesenteric or the iliac veins, and intrathecally at the level of the 7th lumbar vertebra. Femoral nerve-quadriceps preparation showed a characteristic "peripheral after-discharge" for a period of up to 1 second with both HETP and TEPP, in response to single motor volleys. Action potential was displayed on a 40-millisecond sweep of a cathode ray oscillograph amplified from belly tendon leads by a resistance-capacity push-pull amplifier. Supra-maximal stimuli were applied at rates of 1/10 seconds to 100/seconds by means of an electronic switch with air-cored coil. For repetitive stimuli at 10-50/seconds, HETP and TEPP gave complex effects, the peripheral after-discharge disappearing after the first few responses. Initially these drugs increased nerve muscle responses and enhanced knee-jerk, flexor, crossed extensor, and other reflexes. Maximal effects appeared within a few minutes, for larger doses; with threshold doses effects were delayed as much as 5–10 minutes. TEPP was 5–10 times as effective as HETP. HETP and TEPP both antagonized peripheral action of curare on nerve muscle preparation while injections of curare extinguished peripheral after-discharges induced by HETP and TEPP under single motor volleys. Effects of drugs are said to be due to direct action upon the central nervous system and not on circulation and respiration. Attention is drawn to the similarity of action of these phosphates and that of (other) anticholinesterases (eserine, diisopropyl fluorphosphate).

Morris Rockstein (Chem. Abstr.).

The Neuro-vegetative System in Chronic Carbon Monoxide Poisoning. Barthe, Rene, and Paris, Jean. [*Presse med.*, **57**, 217–18 (1949).]

The metabolic rate in chronic CO poisoning may be increased or decreased. CO stimulates the diencephalic centers and produces directly a thyroxine-like effect. An indirect effect by way of the hypophysis tends to lower the metabolic rate.

A. E. Meyer (Chem Abstr.).

Unsaturated Fatty Acids of Blood Serum in Nervous Diseases. Rossini, Romolo. [*Rass. studi psichiat.*, **38**, 8–15 (1949).]

The Iodine number was determined of the Et_2O extract of the blood serum (according to the Ascoli method) of 66 patients. Average values were as follows: psychoneurosis 0·39, epilepsy 0·31, syphilis of nervous centers 0·48, toxic polyneuritis 0·39, degenerative abiotrophic diseases 0·39, neoplasias of the nervous centers 0·63. Values higher than 0·70 indicate neoplasia.

C. Scandura (Chem. Abstr.).

Water, Nitrogen and Electrolyte Content of Brain Following Cerebral Concussion. Eichelberger, Lillian, Kollros, Jerry J., Walker, A. Earl, and Roma, Michael. [*Am. J. Physiol.*, **156**, 129–36 (1949).]

Total water, N, and electrolyte concentrations were determined in brains of dogs following pure concussion uncomplicated by damage to blood vessels. There was no indication of cerebral swelling in these experiments. The total water content of the hemispheres or of the cerebellum did not change significantly. Neither was there any indication of a redistribution of water in the cerebral tissues. Low Ca values were found in the hemispheres of some of the dogs killed after 1½ hours and 5 hours, and of all killed at 24 hours. There was a low Na concentration in the serums of the dogs 24 hours after trauma.

E. D. Walter (Chem. Abstr.).

Influence of Delta and Gamma Benzene Hexachloride on the Oxygen Uptake of Brain. McNamara, Bernard P., and Krop, Stephen. [*Science*, **109**, 330–1 (1949).]

Following intraperitoneal injection of 100 mg./kg. gamma benzene hexachloride (I) to rats to produce central stimulation, or 500 mg./kg. delta-benzene hexachloride (II) to produce central depression, the brain was removed and the QO_2 of brain slices was investigated. No differences were observed between control and test slices. When brain homogenates were treated with peanut oil solutions of (I) or (II) in Kreb's phosphate solution containing 0·1 per cent. glucose at 38°, results obtained indicated that (I) did not affect the O uptake of the brain, although a significant increase was observed with (II). Administration of inositol did not alter these results and (I) exerted no antagonism to the effects of (II).

In view of its narcotic properties *in vivo* the stimulatory effect of (II) on brain respiration *in vitro* is not understood, although oxidation of the compound is a possible explanation. Previous hypotheses concerning the mechanism of action of certain narcotic agents are also considered likely. The reasons for the differing results *in vivo* and *in vitro* are not clear. JOHN P. CRISPELL (Chem. Abstr.).

Adenosinetriphosphatase of the Brain. Epel'baum, S. E., Sheves, G. S., and Kobylin, A. A. [*Biokhimiya*, **14**, 107–12 (1949); *cf. duBois and Potter, C. A.*, **37**, 6685[3].]

The addition of Ca to an aqueous extraction of rabbit brain did not increase the adenosinetriphosphatase activity, but in some cases actually decreased it. Mg had an activating effect. The optimum pH of the enzyme was 7·6–8·0. The aqueous extraction split off 2 labile phosphoric acid residues. The water insoluble protein obtained by extracting rabbit brain with Edsall's solution. (45 g. KCl, 3·57 g. $NaHCO_3$, and 1·1 g. Na_2CO_3, dissolved in a litre of water) possessed some adenosinetriphosphatase activity, but not as much as the aqueous extraction. The addition of $CaCl_2$ activated the enzyme of the protein insoluble in water; an even greater effect was observed on the addition of $MgCl_2$.

H. PRIESTLEY (Chem. Abstr.).

Cytochemical Correlation of Motor Nerve Cells in Spastic Paralysis. Hochberg, Ingrid, and Hyden, Holger. [*Acta Physiol. Scand.*, **17**, *Suppl.* 60, 63 pp., (1949).]

Pronounced spastic paralysis developed in the hind legs of rabbits after 25 minutes of bloodless occlusion of the abdominal aorta. The severe cytological changes resulted in death of the cell. The changes in the affected motor anterior horn cells were studied (15 minutes to 30 days) by microspectrographic and cytochemical methods. Trauma accompanied by impairment or cessation of neuronal function caused a temporary inhibition or cessation of nucleoprotein production in the cytoplasm. With irreversible damage the nerve cell lost its capacity for producing nucleic acids and cytoplasmic protein substances. but disappearance of the cytoplasmic nucleoproteins did not necessarily imply irreversible damage. There was a type of neuronal injury which resulted in a cessation of function (paralysis) and in a dysfunction (spastic condition) with muscular hypertonus. With the onset of slight or moderate spastic paralysis due to occlusion of the abdominal aorta there was a substantial decrease in the cytoplasmic nucleoprotein production. Maintenance of a constant production of nucleoproteins is essential for physiological neuronal activity. During restitution and preceding functional restoration, the nucleoproteins in the cytoplasm increased, which put considerable demand on the capacity of the nucleoprotein-producing capacity. The changes in nucleoprotein content were followed quantitatively in the nucleolus. The chromocenter areas in the nucleus are part of the nucleoprotein-producing system, and the substance in it increased considerably, especially in the phase of restitution. So long as the nucleoprotein content of the nucleolus was satisfactory, the decrease in cytoplasmic nucleoproteins did not indicate irreversible damage. After occlusion of the abdominal aorta for 25 minutes most of the anterior horn cells underwent severe changes and were phagocytosed. Nucleic acids and proteins in both the nuclear apparatus and cytoplasm disappeared at the onset of paralysis and were not replaced by new production. S. E. MORGULIS (Chem. Abstr.).

Relation between Brain and Plasma Electrolytes and Electroshock Seizure Thresholds in Adrenalectomized Rats. Davenport, Virginia D. [*Am. J. Physiol.*, **156**, 322–7 (1949).]

Adrenalectomized rats maintained on 0·9 per cent. NaCl solution have approximate normal electroshock seizure thresholds. On plain water they show a prompt fall in electroshock threshold which is quickly reversed by replacement NaCl or by injection of desoxycorticosterone. Substitution of isotonic KCl or $MgCl_2$ for NaCl solution results in an abrupt fall in electroshock threshold, but on isotonic $CaCl_2$ the adrenalectomized rats are able to maintain normal brain excitability for 4 days. Adrenalectomized rats have normal brain concentrations of water, Cl, Na and K. The electroshock seizure threshold of the adrenalectomized rat is directly correlated with the plasma Na level. E. D. WALTER (Chem. Abstr.).

Breakdown of Cozymase by a System of Nervous Tissue. McIlwain, H. and Rodnight, R. [*Biochem. J.*, **44**, 470–7 (1949); *cf. C. A.*, **43**, 5432*g*.]

The velocity of breakdown of cozymase by nervous tissue is 0·4–1·8μ mol./mg. dry weight/hour. At this rate, which often exceeds the rate of respiration, the tissue could break down its own dry weight of cozymase per hour. This velocity is reached at the concentration of cozymase in the tissue which in the brain is 5×10^{-4} M; half the maximum velocity is attained at less than 1×10^{-4} M cozymase. The reaction is inhibited by nicotinamide (1×10^{-3} M reduces the rate of breakdown to half). The reaction is most rapid in damaged tissue and results in loss of catalytic activity. It leads to formation of H ions, 1 acid equivalent per molecule nicotinamide liberated. The optimum activity is at pH 7 and is not affected by many inorganic salts. The factor responsible for the reactions remains in the tissue debris suspended in isotonic solutions; it is stable at 37° but is rapidly inactivated at 70°. S. Morgulis (Chem. Abstr.).

Injuries of the Nervous System after the Feeding of Synthetic Fats to Animals. Schaltenbrand, G., and Schorn, J. [*Deut. Z. Nervenheilk.*, **159**, 408–16 (1948).]

Various fats, synthetised from coal, were fed to rats at a level of 57 or 64 per cent. of the total dietary calorie. With most of the fats toxic symptoms ensued, particularly severe with a synthetic oil containing largely 9, 10 and 11C fat acids. The same diet with 60 per cent. of the calories as coconut or peanut oil produced no symptoms. On a diet containing triglycerides made from 10 and 11C fat acids, within 4–6 days 25 rats developed a shaggy coat and severe spastic paresis of the legs. At autopsy, areas of softening in the spinal cord and medulla, and meningeal bleeding were found. When the synthetic fat was removed from the diet, the symptoms gradually regressed toward normal. A similar toxic-effect of synthetic fats was observed in monkeys. Warren M. Sperry (Chem. Abstr.).

Conduction of Excitations in the Nerves. Lissák, Kálmán. [*Orvosok Lapha és Népegészségügy*, **3**, 2113–18 (1947).]

Theories and experimental results on the mechanism of conduction of nerve excitation are summarized. Most probably it is an electrochemical process in which the metabolic processes are closely correlated with the electrical potential produced. Istvân Finàly (Chem. Abstr.).

Effect of Potassium and Calcium Ions on Thermal Stimulation and Spontaneous Activity of Mammalian Nerve Fibers. Laget, Paul, and Lundberg, Anders. [*Acta Physiol., Scand.* **18**, 128–38 (1949).]

A fibers (motor roots) are excited by cooling while *C* fibers (splenic nerves) are by heating, and it is known that the maximum nerve membrane potential of the former is attained at 37° and of the latter at 25°. It is also known that a low K-ion-concentration so affects *A* fibers as to make their temperature potential curve like that of *C* fibers, and a high K-ion concentration makes *C* fibers behave like the *A* fibers. It was found that, when Ca^{++} and K^{+} are removed from cooled *A* fibers, they give a synchronous discharge at 100/seconds at 25°; the amplitude showed a regular fluctuation at 7/seconds. The same was true for K-ion free nerves discharging spontaneously because of excess of PO_4 ions. The slow amplitude wave has a temperature coefficient Q_{10} of about 10.

S. Morgulis (Chem. Abstr.).

Accumulation of Glutamic Acid in Isolated Brain Tissue. Stern, J. R., Eggleston, L. V., Hems, R., and Krebs, H. A. [*Biochem. J.*, **44**, 410–18 (1949).]

In slices of brain cortex glutamic acid is transported from the medium against a concentration gradient. In guinea-pig brain cortex the transfer is stopped when the difference between internal and external concentrations is about 0·02 M, this difference being more or less independent of the absolute external level. Energy is essential for this transfer. NaF, which interferes with energy production, also prevents accumulation of glutamate. Glucose oxidation is the most efficient source of energy. Anaerobically no appreciable accumulation occurs. As long as brain tissue receives glucose, and the enzyme systems are intact, glutamate enters the brain tissue from the medium, but not in the reverse direction. If energy production stops, the glutamate migrates from tissue into the medium. The permeability of brain tissue for glutamate is controlled by energy-yielding metabolic processes. S. MORGULIS (Chem. Abstr.).

Concentration of Lipides in the Brain of Infants and Adults. Johnson, A. C., McNabb, A. R., and Rossiter, R. J. [*Biochem. J.*, **44**, 494–8 (1949).]

The gray and white matter of brains from infants and adults were separately analyzed for various lipides (cerebrosides, total and free cholesterol, total phospholipide, lecithin, cephalin and sphingomyelin). In the infant brain the distribution of lipides in the white and gray matter is similar and also resembles that of the gray matter of the adult. The white matter of the adult has a higher concentration of cerebrosides, free cholesterol and sphingomyelin than of the infant brain. Although the total phospholipide content of white matter (on a dry-weight basis) is about the same for adult or infant brain, the former contains more sphingomyelin and less lecithin. The conclusion is reached that the chief lipide components of " myelin " sheaths of nerve fibers are cerebroside, free cholesterol and sphingomyelin. S. MORGULIS (Chem. Abstr.).

Use of Isotopes in Study of the Nervous System. Solomon, A., Selverstone, B., and Sweet, W. [*Trans. Am. Neurol. Assoc.*, **73**, 179 (1948).]

A demonstration illustrated the use of radioactive and stable isotopes in neurological research, their assay by the Geiger counter and mass-spectrometer, analyses of brain tissue, brain tumor, cerebrospinal fluid and blood, and measurement *in situ* of cerebral radioactivity. MARION HORN PESKIN (Chem. Abstr.).

Regulation of Lactation by Reflexes. Grachev, I. I. [*Zhur. Obshchei Biol.*, **10**, 303–15 (1949).]

Experimental evidence is reviewed which indicates that lactation is regulated, not by the endocrine system through hormones, but by the nervous system through reflexes (e.g. from suckling and from manual or mechanical milking.).

JULIAN F. SMITH (Chem. Abstr.).

A Chemical Analysis of Phospholipides of the Brain in Disseminated Sclerosis. Weil, Arthur. [*Trans. Am. Neurol. Assoc.*, **73**, 232–3 (1948).]

MARION HORN PESKIN (Chem. Abstr.).

Physiological Pathology of Insanity. Ludlum, Seymour DeWitt. [*Trans. Am. Neurol. Assoc.*, **73**, 154–6 (1948).]

A state of low temperature, low blood pressure, high osmotic pressure, lymphocytic leukopenia, low sedimentation, low serum globulin, and high serum albumin was found on recovery in one group of patients of the schizophrenic type, and on relapse in another group of the manic-depressive type.

MARION HORN PESKIN (Chem. Abstr.).

Effect of Drugs on Intracranial Circulation in Patients with Chronic Headache Studied by Means of Arteriography. Friedman, Arnold P., Feiring, Emanuel, and Davidoff, Leo M. [*Trans. Am. Neurol. Assoc.*, **73**, 124–7 (1948).]

Arteriography by means of diodrast injected into the carotid artery showed dilatation of the intracranial blood vessels after intravenous injection of 0·275 mg. histamine diphosphate, and decrease in size of the vessels after intravenous injection of 0·5 mg. ergotamine tartrate, in 2 of 4 patients with chronic recurring headache.

MARION HORN PESKIN (Chem. Abstr.).

Radio-active Isotopes in the Study of Intracranial Tumors. Selverstone, B., and Solomon, A. K. [*Trans. Am. Neurol. Assoc.*, **73**, 115–19 (1948).]

When a solution containing 0·8–3·8 millicuries of phosphate containing P^{32} was injected intravenously into patients with brain tumors, the tumors showed P^{32} contents 5·5–112 times those of normal white matter of the brain and consistently higher than those in the blood stream at the same time. Areas of more rapid growth in glioblastoma took up P^{32} more rapidly than did quiescent areas. Glioblastoma showed higher concentrations than astrocytoma. Concentrations in meningioma paralleled cellularity. Localization and demarcation of subcortical cerebral tumors are being investigated by means of increased uptake of P^{32}.

MARION HORN PESKIN (Chem. Abstr.).

Cerebral Blood Flow and Cerebral Oxygen Consumption in Experimental Intracranial Injury. German, Wm. J., Page, W. Randolph, and Nims, Leslie F. [*Trans. Am. Neurol. Assoc.*, **72**, 86–8 (1947).]

One-half to 3 hours after severe intracranial injury dogs showed increased body temperature, cerebral blood flow and cerebral O_2 consumption, and decreased cerebral vascular resistance. M. H. PESKIN (Chem. Abstr.).

The Cerebral Blood Flow and Metabolism in Idiopathic Epilepsy. Grant, Francis C., Spitz, Eugene B., Shenkin, Henry A., Schmidt, Carl F., and Kety, Seymour S. [*Trans. Am. Neurol. Assoc.*, **72**, 82–6 (1947).]

Cerebral blood flow and O_2 consumption values, blood composition, and reaction to hyperventilation in 12 epileptics were not significantly different from those in 35 normal controls. The somewhat lower CO_2 content in the arterial blood of the epileptics had questionable significance and probably indicated only a greater emotional instability and tendency to hyperventilate under stress. There was no correlation between the clinical severity of the epilepsy and the cerebral blood flow or O_2 consumption. Of 4 patients studied after intravenous injection of metrazole, only 1 showed a marked and prolonged increase in electroencephalographic activity without a clinical convulsion ; in this patient the cerebral blood flow did not change significantly although the cerebral O_2 consumption rose markedly. The 3 patients studied after metrazole convulsions all showed acidosis and markedly decreased cerebral blood flow and cerebral O_2 consumption. The findings suggest that post-convulsive depression in epileptics may be associated with similar decrease in cerebral blood flow and O_2 consumption.

MARION HORN PESKIN (Chem. Abstr.).

Studies in Convulsive Thresholds. II, Convulsive Threshold in Epileptics and Non-epileptics. Ziskind, Eugene, and Bercel, Nicholas A. [*Trans. Am. Neurol. Assoc.*, **71**, 83–9 (1946).]

The minimum intravenous dose of 16 per cent. metrazole which caused a response in the electroencephalogram was 2·3 c.c. in epileptics and 3·4 c.c. in non-epileptics. Epileptics with infrequent attacks showed higher threshold doses than those with frequent attacks.

Phenobarbital and dilantin increased the threshold of epileptics.

MARION HORN PESKIN (Chem. Abstr.).

Iron and Copper Metabolism during Childhood. The Understanding of Schizophrenia. Brenner, Walter, and Breier, Almut. [*Z. Kinderheilk.*, **66**, 620–46 (1949) ; *cf. C. A.*, **43**, 8520*f*.]

Analyses of the blood serum of 8 schizophrenic children and of 24 children with other, non-schizophrenic mental conditions showed that the serum Fe content of the schizophrenic children was normal, but that the serum Cu content was elevated, at times as much as 200 per cent. It is suggested that serum Cu analyses can be used diagnostically to differentiate between schizophrenia and psychopathy, idiocy, epileptic dementia, etc. BRUNO VASSEL (Chem. Abstr.).

Biochemical Analysis of grand mal *Type of Electrical Pattern* [*Produced by Diisopropyl Fluorphosphate (DFP). Freedman, A. M., Bales, P. D., Willis, Alice M., and Himwich, H. E.* [*Trans. Am. Neurol. Assoc.*, **73**, 64–7 (1948).]

Electrical patterns (studied by a potentiometric method) similar to those seen in idiopathic epilepsy were produced in rabbits by intracarotid injection of DFP. For electrical changes short of the *grand mal* pattern, extreme depression of the cholinesterase activity in the cerebral hemisphere on the injected side was a constant concomitant. With the *grand mal* pattern, depression of the cholinesterase activity in subcortical areas was also observed.

MARION HORN PESKIN (Chem. Abstr.).

The Formation of Acetate in Brain-tissue Suspensions. Webb, J. L., and Elliot, K. A. C. [*Can. J. Research* 26E, 239–49 (1948).]

Studies on acetate (I) and acyl phosphate (II) formation in isotonic rat-brain suspensions containing 150 mg. of tissue per ml. are reported. In the presence of 0·025 M. pyruvate (III) an average of 9·9μ molecules (I) per g. was obtained after 2 hours of incubation. In the absence of (III) smaller amounts of (I) were formed. Very small amounts of (II) which were already present in brain suspensions did not increase upon (I) or (III) addition. Brain suspensions were found to split 70 per cent. of added 0·007 M lithium (II) in 5 minutes at 38°, but the rate of splitting decreased 85 per cent. in the presence of 0·11 M phosphate. In brain homogenates 2μ molecules of material analyzing as (II) were found when 2 M NH_4OH was present. Lithium-(II) did not affect the O consumption in the presence of 0·11 M phosphate. Significant increases in (I) production from (III) were observed in the presence of malonate, malonate causing a 5 per cent. inhibition of O consumption with (III) and glucose. Thiamine addition, and to a lesser extent malate and α-ketoglutarate, also increased (I) formation. The addition of 0·02 to 0·1 M (I) had no effect on respiration or (I) formation with or without (III). A considerable non-enzymic formation of (I) from (III) (0·025 M) when incubated with ascorbate (0·015 M) at pH 7·2 and 38° was observed in the presence or absence of tissue. However, the ascorbate concentration of the brain suspensions used would be too low to produce this effect. KURT I. ALTMAN (Chem. Abstr.).

Experimental Study of Contrast Media for Cerebral Angiography with Reference to Possible Injurious Effects on the Cerebral Blood Vessels. Broman, Tore, and Olsson, Olle. [*Acta Radiol.*, **31**, 321–34 (1949).]

With the application times (maximum 40 seconds) used in the tests all the contrast media, except Umbradil (diethanolamine salt of 3,5-diiodo-4-pyridione-N-acetic acid) and Umbradil-methyl-glucamine in 35 per cent. solution produced a lesion of the cerebral vessels. Compared with other contrast media of equal concentration Umbradil forte proved but slightly injurious. The injury consisted of a disorder of the vascular permeability recognized by a manifest impairment of the blood-brain-barrier. When injury was rather marked, attendant stasis and punctate hemorrhages were also observed. As certain indifferent substances (NaCl, glucose) evidently required a higher osmotic pressure to produce a manifest injury, the cerebral lesions observed could not be attributed solely to an osmotic action, but must have been the result of a chemo-toxic effect.

G. L. CLARK (Chem. Abstr.).

Studies on Glycolysis of Brain Preparations. V, Affinity of Hexokinase for Glucose and Fructose. Meyerhof, Otto and Wilson, Jean R. [*Arch. Biochem.*, **19**, 502–8 (1948); *cf. C. A.*, **42**, 7799*d*.]

A difference in the turnover rates of glucose and fructose in centrifuged brain extracts was demonstrated in the presence of high amounts of adenosine triphosphate (I) and low amounts of sugar; transphosphorylation between (I) and fructose was diminished in the presence of hexokinase inhibitors.

VERNON L. FRAMPTON (Chem. Abstr.).

Does the Nervous Sytsem Intervene in the Fixation of Calcium in Bone? Hermann, Henri, Drevon, B., and Cier, J. F. [*Compt. rend. soc. biol.*, **143**, 275–7 (1949).]

Tails of young rats cut off and grafted back on showed normal growth and bone calcification in absence of nerve connection. L. E. GILSON (Chem. Abstr.).

A Neural Factor in the Mechanism by which Estrogen Induces the Release of Luteinizing Hormone in the Rat. Sawyer, Charles H., Everett, John W., and Markee, J. E. [*Endocrinology*, **44**, 218–33 (1949).]

The nervous system appears to be involved in the estrogen-induced discharge of hypophyseal leutinizing hormone (I) in the rat. In the pregnant rat, injection of estrogen on day 4 is followed within 48 hours by ovulation and storage of cholesterol in the corpora lutea. Both of these phenomena indicate (I) release, and they can be duplicated by injecting (I) on the 5th day of pregnancy. If the potent adrenergic-blocking agent, dibenamine, is injected prior to, or as much as 20 hours after, estrogen injection ovulation and luteal cholesterolization are prevented in a high proportion of the animals. The effects of (I) are not counteracted by dibenamine. The anticholinergic drug atropine also allows injected (I) to manifest its effects, but, like dibenamine, blocks estrogen-induced ovulation and luteal accumulation of cholesterol. Dibenamine and atropine appear to prevent the release of (I) only by blocking neurogenic stimuli from reaching the hypophysis. They interfere neither with the mechanism of glandular discharge of the hormone nor with its action on its target organs.

A Neurogenic Timing Factor in Control of the ovulatory Discharge of Luteinizing Hormone in the Cyclic Rat. Everett, John W., Sawyer, Charles H., and Markee, J. E. [*Ibid.*, 234–50.]

Further experiments on the effects of dibenamine and atropine administered at different times during the estrous cycle are reported and discussed.

Interpretation of Experimental Results Obtained with Dibenamine. Nickerson, Mark. [*Ibid.*, 287–8.]

Criticism and discussion of the apparent effects of dibenamine reported above.

L. E. Gilson (Chem. Abstr.).

Effects of Adrenocorticotropic Hormone on Neuromuscular Function in Patients with Myasthenia Gravis. Torda, Clara, and Wolff, Harold G. [*Proc. Soc. Exptl. Biol. Med.*, **71**, 432–5 (1949).]

The injection of 20 mgm. of the hormone every 6 hours (total dosage 400 mgm.) produced a long-lasting partial remission of the symptoms. The ability of the patient's serum to support acetylcholine synthesis was increased.

L. E. Gilson (Chem. Abstr.).

Lipides of the Nervous System during in vitro *Degeneration. Johnson, A. C., McNabb, A. R., and Rossiter, R. J.* [*Can. J. Research*, **27E**, 63–71 (1949).]

No significant change occurred in the concentration of lipides of brain slices incubated 24 hours with normal saline or with Krebs bicarbonate buffer. A significant decrease in total phospholipide, sphingomyelin and cephalin occurred after incubation for 7 days in Krebs buffer in CO_2–O_2 mixture. When O_2 was replaced by N, only phospholipide and cephalin decreased. In brain slices incubated for 14 days there was a great decrease in concentration of total phospholipide, with no change in cerebroside or cholesterol concentrations, but a decrease in concentration of sphingomyelin and cephalin. In sciatic nerve incubated for 8 days the concentration of cephalin and possibly of total phospholipide decreased, but the concentration of cerebroside, cholesterol, sphingomyelin or lecithin remained unchanged. Thus in tissue of the nervous system there appears to be a phospholipide-splitting mechanism, possibly enzymic in nature.

L. L. K. (Chem. Abstr.).

Influence of Pituitary on Phosphorus Metabolism of Brain. Reiss, M., Badrick, F. E., and Halkerston, Jean M. [*Biochem. J.*, **44**, 257–60 (1949).]

Hypophysectomy results not only in increased hexokinase activity and anaerobic glycolysis, but also in greater P uptake by the rat brain and pineal. The latter may possibly be due to increased carbohydrate metabolism. The previous report that the pineal has the largest P uptake is confirmed. The pineal also has a very high activity with regard to I^{131}. It is suggested that possibly the pituitary inhibits and thus controls the activity of the pineal. It was found that corticotropic hormone administered to hypophysectomized animals before the P injection restores its absorption to the normal level. S. Morgulis (Chem. Abstr.).

Origin in the Central Nervous System of Gastric Secretory Impulses Induced by Hypoglycemia. Jogi, Prits, Strom, Gunnar, and Uvnas, Borje. [*Acta Physiol. Scand.*, **17**, 212–21 (1949).]

Vagal secretory impulses could be induced either by removal of inhibitory influences (cortical) or by activation of subcortical regions. In most decerebrated dogs the gastric secretory response to insulin hypoglycemia disappears, but in a few operated animals a reduced and delayed response remains. This indicates that the hypoglycemia can activate vagal medullary centers.

S. MORGULIS (Chem. Abstr.).

Newer Concepts of Schizophrenia. Ewalt, J. R., and Bruce, E. I. [*Texas Repts. Biol. Med.*, **6**, 97–107 (1948).]

A review outlining some of the effects of antireticular-cytotoxic serum and glutamic acid as well as pathological studies of schizophrenia.

A. HALPERN (Chem. Abstr.).

Changes in Sorptive Properties of Nerve Cells in Rabbits under Traumatic Shock. Romanov, S. N. [*Zhur. Obshchei. Biol.* (*J. Gen. Biol.*), **10**, No. 2, 76–88 (1949).]

Traumatic shock (by hind leg injury) in rabbits alters the adsorptive capacity of nerve cells from spinal ganglia for neutral red from 0·01 per cent. solution. Cells from the jugular-pectoral region adsorbed 5–7 times as much dye as cells from sacrolumbar ganglia. Curves plotting percentage increase in sorption (over controls) against time tend to have a peak at about 15 minutes (attributed to trauma) and a higher peak at about 60 minutes (attributed to glandular secretions). Hypotonic Ringer solution caused severe paranecrosis in nerve cells from traumatized rabbits ; controls showed no change. JULIAN F. SMITH (Chem. Abstr.).

Some Effects of Diisopropyl Fluophosphate (*DFP*) *and Fluoroacetate on the Central Nervous System. Kelen, Andrew, and McEachern, Donald.* [*Can. J. Research*, **27E**, 146–57 (1949).]

Cats were given intracarotid and intracisternal injections of the anticholinesterase DFP. These produced no convulsions, but systemic symptoms appeared and plasma cholinesterase was reduced. Intracarotid DFP produced prolonged ipsilateral myosis and salivation. Electroencephalogram changes on the side of the injection were found in one of the two trials. Intracisternal DFP increased the duration of pentothal anesthesia, and caused a temporary loss of sensation in the fore limbs and cornea, with weakness of the hind limbs. Intracisternal fluoroacetate produced scissor spasms, scratching seizures, and myoclonic jerks. Seizures persisted for hours unless stopped by nembutal. Cerebrospinal fluid was tested for acetylcholine, the minimum amount detectable being 0·4 to 3·0 γ per cent. After intravenous injections of 5 mgm./kgm. acetylcholine was found in the cerebrospinal fluid. Intravenous injection of 1·5 mgm./kgm. of DFP followed by thujone produced small amounts of acetylcholine. After intracisternal injections of DFP, injections of Na fluoroacetate, and electric shock experiments no significant amounts of acetylcholine were found. LA VERNE L. KIESSLING (Chem. Abstr.).

Influence of Amphetamine Sulfate on Cerebral Metabolism and Blood Flow in Man. Abreu, Benedict E., Liddle, Grant W., Burks, Arthur L., Sutherland, Violette, Elliott, Henry W., Simon, Alexander, and Margolis, Lester. [*J. Am. Pharm. Assoc.*, **38**, 186–8 (1949).]

The administration of 20 mgm. amphetamine sulfate intravenously increased mean blood pressure and reduced cerebral blood flow and O uptake in the majority of subjects. DAVID B. SABINE (Chem. Abstr.).

The Toxicity of Vesicants and Some Other Compounds to the Pyruvate Oxidase System (*Brain*). *Peters, R. A., and Wakelin, R. W.* [*Brit. J. Pharmacol.*, **4**, 51–62 (1949) ; *cf. C. A.*, **42**, 3078*g*.]

The toxicities of dichlorodiethyl sulfone (I), trichlorotriethylamine, divinyl sulfone (II), dichlorodiethyl sulfoxide, phenyl 2-chloroethyl sulfone, iodoacetic acid, idoacetamide, and the non-vesicants thiodiglycol and dihydroxydiethyl sulfone to the pyruvate oxidase (III) system in pigeon brain were determined. The most toxic were (I) and (II) ; they attack a –SH group. The (III) system is selectively poisoned by mustard gas (IV) at concentrations which do not effect the other parts of the system, but this concentration is much larger than that required by the arsenicals or of (I) and (II). On emulsification with lecithin (IV) could serve as a test for antidotes. There is evidence that it is not attacking the –SH group alone. (I), (II), (IV) attacked the (III) system selectively, and the (III) components of the total oxidase system; the toxic action upon succinic, malate and the lactate dehydrogenases was much less marked, and no toxic action upon amino acid oxidase was noted at the concentrations used. It is concluded that the (III) studied includes the tricarboxylic acid cycle.

H. O. Singher (Chem. Abstr.).

2. Pharmacology and Treatment.

Action of Methyl Fluoroacetate on Respiration and Potential of Nerve. Boyarsky, L. L., Rosenblatt, A. D., Postel, S., and Gerard, R. W. [Am. J. Physiol., **157**, 291–8 (1949).]

Na fluoroacetate is almost inactive on frog sciatic nerve. Conduction is unaffected at 0·001 M concentration and O consumption is only 50 per cent. depressed. Methyl fluoroacetate (MFA) interferes with resting metabolism and leads to irreversible conduction block, large fibers before small ones, after a latent period during which threshold is rising. In summer frogs 0·005 M MFA blocks conduction in 3 to 4 hours by raising the threshold 2- to over 5-fold and slowing conduction 2-fold or more. Resting potential and spike height, for individual fibers, are not altered. Resting O consumption is cut to 70 per cent. normal by 0·001 M MFA to 20 per cent. by 0·005 M. Fumarate and succinate protect against MFA action; ethanol, acetate, pyruvate, α-keto-glutarate, and glucose are ineffective. These findings emphasize the safety factor in nerve metabolism and the metabolic difference between nerve and muscle, and support the existence and functional importance of a tricarboxylic cycle in nerve metabolism. E. D. Walter (Chem. Abstr.).

Influence of Antipyrine on Respiration, Glycolysis and Cholinesterase Activity in Rat Brain. Peiss, C. N., Hall, V. E., and Field, J. [Am. J. Physiol., **157**, 287–90 (1949); *cf. preceding abstract.*]

Antipyrine, when added to the medium in which slices of rat cerebral cortex are suspended, has no effect on the rate of O consumption at 37·5° in concentrations below 2×10^{-3} M. At concentrations greater than this, slight depression of respiration occurs. Anaerobic glycolysis in brain slices and cholinesterase activity in brain homogenates are depressed by concentrations of antipyrine above 1×10^{-3} M. The possible bearing of these metabolic effects of antipyrine on its antipyretic action is discussed. E. D. Walter (Chem. Abstr.).

Effect of Drugs on Synapses. Eichholtz, F., and Roesch, E. [Arch. intern. Pharmacodynamie, **78**, 521–31 (1949).]

The release of adrenaline from chromaffin tissue was measured by blood pressure rise and spleen contraction in decapitated cats given artificial respiration and 10 per cent. CO_2. The action of nicotine, acetylcholine and doryl is absent if no CO_2 is given. The effect of acetylcholine is enhanced by prostigmine and eserine. Doryl acts in the same concentration as acetylcholine but mecholyl has no effect. Curare, procaine and quinine depress the "nicotinic" action of acetylcholine, doryl and nicotine. Ferrous salts stimulate the release of adrenaline from chromaffin tissue by direct action. M. L. C. Bernheim (Chem. Abstr.).

The Influence of Magnesium on Respiration, Glycolysis and Cholinesterase Activity in Rat Brain. Peiss, C. N., Hall, V. F., and Field, J. [J. Physiol. (London), **108**, 365–73 (1949).]

In the attempt to get information concerning thermoregulatory processes of higher vertebrates by the use of Mg, 40–50 mgm. samples of cerebral cortex slices of 0·4–5 mm. thickness, from brains of Slonaker-Wistar adult albino rats, were dried to constant weight in an electric oven at 105°. Manometric measurements were made in constant temperature bath at 37·5 ± 0·01°. Respiration was measured by the Warburg manometer in an O atm. with 5 per cent. KPH in filter-paper wicks, 0·011 M glucose in Ringer-phosphate solution in the main compartment, and pre-added graded amts. of $MgCl_2$ in Ringer-Krebs solution in the sidearms.

Contents of main vessel and sidearms were mixed after 30 minutes. Anaerobic glycolysis was measured manometrically in 95 per cent. N-5 per cent. CO_2 (O-free by hot copper method) at a fixed rate of flow, in Ringer-bicarbonate plus 0·011 M glucose, with additions of $MgCl_2$ in concentrations up to $43 \cdot 7 \times 10^{-3}$ M (not pre-added). Cholinesterase activity was determined by the Nachmansohn-Feld manometric method (*C. A.* (**42**), 2025*f*) with homogenized whole rat brain in ice-cold Ca-free Ringer-bicarbonate solution plus variable $MgCl_2$ in main vessel, and 0·015 M (final concentration) acetylcholine in sidearm, in a 95 per cent. N-5 per cent. CO_2 atmosphere. All readings were made at 5-min. intervals for 40 minutes. Mg concentrations above $8 \cdot 75 \times 10^{-3}$ M inhibited respiration up to 20 per cent. inhibition at $29 \cdot 2 \times 10^{-3}$ M (considerably above physiol. range of serum). From zero to $12 \cdot 5 \times 10^{-3}$ M increase in Mg-ion level resulted in a progressive rise in rate of glycolysis to a maximum of 60 per cent. above the control (containing $1 \cdot 19 \times 10^{-3}$ M Mg) glycolysis decreasing thereafter. However, even at $43 \cdot 7 \times 10^{-3}$ M Mg concentration, glycolytic rate remained at 30 per cent. above control. Change in Mg concentrations from zero to $41 \cdot 7 \times 10^{-3}$ M for the supernatant fraction of centrifuge whole rat brain for homogenate had no effect on cholinesterase activity. It is suggested that the influence of Mg on anaerobic glycolysis in the central nervous system may provide a clue to the mechanisms of Mg effect on temperature regulation in homeotherms. MORRIS ROCKSTEIN (Chem. Abstr.).

Anticonvulsant Action of Paraldehyde on the Nervous System. Membrado, J. Elio, Jalon, G. de, and Obrador, S. [*Farmacoterap. actual* (*Madrid*), **5**, 538–47 (1948).]

Doses of 1 to 3 c.c. in man cause coughing ; 0·1 g. per kgm. given intravenously has a mild hypnotic effect, higher doses have a marked narcotic effect and stimulate respiration. The toxicity is low. The response to stimulation of the motor cortex in man and cats decreases after intravenous small doses. Convulsions appearing during neurosurgical intervention cease immediately. The spontaneous cortical activity can be abolished completely for varying periods. The effect of metrazole and strychnine is abolished. The effect of paraldehyde is manifest also in decerebrate and spinal animals. It elevates the threshold for electroshock. There is also a less important depressor and paralyzing effect on neuromuscular and ganglionic synapses. A. E. MEYER (Chem. Abstr.).

Difference between Morphine and Synthetic Analgesics in their Actions on Ganglionic Transmission. Hebb, C. O., and Konzett, H. [*Nature*, **163** 720–1 (1949).]

Pethidine-HCl (I), *l*-(II) and *dl*-amidone (III), when injected into the superior cervical ganglion of the cat, depress or abolish responses of the nictitating membranes to electric stimulation, acetylcholine and KCl. Effective dosage of (I) was 10–100γ, of (II) was 1–10α and of (III) was 5–50α. Morphine in doses as large as 2 mgm., does not react in this manner. Intravenous injection in the cat and action on the frog indicate that (I), (II) and (III) are depressant in action and are more dangerous than morphine. WILLIAM M. MCCORD (Chem. Abstr).

DDT Poisoning. Histopathologic Observations on the Central Nervous System in So-treated Monkeys, Dogs, Cats and Rats. Globus, Joseph H. [*Trans. Am. Neurol. Assoc.*, **73**, 202–8 (1948).]

After reviewing the literature on DDT poisoning in man and lower mammals, G. presents original observations on the brain and spinal cords of monkeys, dogs, cats and rats which had received DDT in large quantities over varying lengths of time ; no pathological alterations were found.

MARION HORN PESKIN (Chem. Abstr.).

Preliminary Report on Clinical Trials of Antabuse. Bell, R. G., and Ward Smith, H. [*Can. Med. Assoc. J.*, **60**, 286–8 (1949).]

A description of the effects of small doses of EtOH administered to persons who have received antabuse (tetra-ethylthiuram disulfide) for several days.

H. WARD SMITH (Chem. Abstr.).

Variations in Bromide of the Blood after Electric Shock. Urechia, C. I., Cosmulescu, I, and Micon, D. [*Confinia Neurol.*, **9**, 392–5 (1949).]

In 7 patients with manic-depressive psychosis the bromide concentration of the blood increased, usually at ½ or 1 hour, after electric shock. In 8 patients with schizophrenia, decreases and increases in bromide concentration were observed.

WARREN M. SPERRY (Chem. Abstr.).

Difference between Drug Effects on Axonal Conduction and Synaptic Transmission. Nachmansohn, David. [*Trans. Am. Neurol. Assoc.*, **72**, 42–6 (1947).]

Effects of acetylcholine, cholinesterase, choline acetylase, eserine, diisopropyl fluophosphate, prostigmine, and curare are discussed.

MARION HORN PESKIN (Chem. Abstr.).

Comparative Efficacies of Anticonvulsants Studied with a New Technique. Bercel, Nicholas A., and Ziskind, Eugene. [*Trans. Am. Neurol. Assoc.*, **72**, 173–6 (1947).]

The minimum doses of anticonvulsants distorting the normal encephalogram of rabbits and the effect of these doses on the convulsive threshold dose of metrazole were determined. Results showed phenobarbital and mesantoin to be the most effective anticonvulsants, with tridione next. Dilantin showed little if any effect.

MARION HORN PESKIN (Chem. Abstr.).

Variations in Venous Blood after Electroshock. Urechia, C. I., Cosmulesco, Ilie, Giossa, E., and Micu. [*Presse med.*, **57**, 199 (1949).]

Before shock, venous blood contains more H_2O than capillary blood. The ratio is reversed after shock except in patients having received many shock treatments.

A. E. MEYER (Chem. Abstr.).

Anticonvulsive Action and Molecular Structure of Some Pentagonal Heterocyclic Compounds. VI, Influence of Substitution at the 5 Positions. Hazard, Rene, Cheymol, Jean, Chambrier, Pierre, and Smarzewska, Klaudia. [*Compt. rend.*, **228**, 176–84 (1949) ; *cf. C. A.*, **43**, 5500*c*.]

Dithiohydantoins show a marked anticonvulsive action. The action of previously reported derivatives is compared with that of the derivatives formed by substituting H, Me, Tt, Ph, or cyclohexyl for R or R′ at the 5 positions in the formula $\underline{\text{CRR}'.\text{NH}.\text{CS}.\text{NH}.\text{CS}}$. When H or Me are substituted, the compounds are inactive. The di-Me (I), MeEt and di-Et derivatives give complete protection. However, lengthening the chain at position 5 has a hypnotic effect and increases the toxicity. Introduction of 1 or 2 Ph radicals diminishes the activity and considerably increases the toxicity. The cyclohexyl derivative is only slightly toxic but does not give full protection. (I) affords the best protection and is the least toxic of all the compounds studied.

DOROTHY A. MEYER (Chem. Abstr.).

Experimental Production of Electrical Major Convulsive Patterns. Freedman, A. M., Bales, P. D., Willis, Alice, and Himwich, H. E. [*Am. J. Physiol.*, **156**, 117–24 (1949).]

Intracarotid injection of diisopropyl fluophosphate into curarized rabbits produced high amplitude rapid frequency waves on the electrocardiogram similar to those seen in *grand mal* seizures of status epilepticus. Various patterns were demonstrated that resemble other epileptic tracings. These electric changes were associated with extreme decrease of cholinesterase activity, but in no instance was all such activity eliminated. Because of the destruction of cholinesterase it is probable that the convulsant patterns are produced by the excessive accumulation of a normal metabolic product of the brain, namely, acetylcholine, an interpretation supported by the prevention of seizure patterns by the injection of atropine.

E. D. WALTER (Chem. Abstr.).

The Buffering Capacity of Brain Tissue after Insulin and Metrazole Shock (*Animal Experiments*). *Mehring, Eugen, and Selbach, Helmut.* [*Arch. Psychiat. Nervenkrankh.*, **116**, 447–63 (1943).]

Tissue from brain (cortex and white matter), liver, kidney, and muscle of rabbits was immersed either in 0·066 M Na_2HPO_4 or 0·066 M KH_2PO_4 and the pH was determined under carefully controlled conditions after 6, 10, and 22 hours. In normal animals the changes in pH toward neutrality at 10 hours were about the same for all tissues; approximately 0·30 pH unit in the acid, and 0·15 in the alkaline buffer. After insulin or metrazole shock the changes in pH at 10 hours were less than in normal rabbits. There was some variation among tissues in the degree of inhibition in buffering capacity.

The Buffering Capacity of Brain Tissue and its Relation to Histopathological Changes after Experimental Concussion of the Brain. Peters, Gerd, and Selbach, Helmut. [*Ibid.*, 531–52.]

The buffering capacity of brain tissue against acid was decreased 2 minutes after experimental concussion and still further decreased at 5 minutes. There was no change in the buffering capacity against alkali.

WARREN M. SPERRY (Chem. Abstr.).

Influence of Induced Hypoglucemia on the Encephalogram of Epileptics. Baisset, A., Bugnard, L., Grezes-Rueff, F. A., Grezes-Rueff, Ch., and Planquier. [*Presse med.*, **56**, 778–9 (1948).]

The encephalographic changes caused by insulin hypoglucemia are about 10 times more marked in epileptics than in normal persons. The wave characteristics for epileptics are accentuated. Insulin injections facilitate the detection of epileptic states.

A. E. MEYER (Chem. Abstr.).

The Effect of Anticonvulsant Therapy on the Electroencephalogram of Patients with Idiopathic Epilepsy. Hoffer, Paul F. A., Hoff, Hans H., and Pluvinage, R. I. L. [*Trans. Am. Neurol. Assoc.*, **72**, 185–8 (1947).]

Among 96 patients treated with phenobarbital, dilantin, hydantoin, or tridione, the electroencephalograms tended to become more normal with adequate therapy.

MARION HORN PESKIN (Chem. Abstr.).

A Study of Levels of Consciousness based on Electroencephalographic Data in Pentothal Anesthesia. Finesinger, Jacob E., Brazier, Mary A. B., Tucci, John H., and Miles, Henry H. W. [*Trans. Am. Neurol. Assoc.*, **72**, 183–5 (1947).]

Electrocardiographic changes during the various stages of pentothal anesthesia are described. Equivocal results were obtained in attempts to influence the anesthesia with Na succinate.

MARION HORN PESKIN (Chem. Abstr.).

Pentothal Anesthesia: Physiologic Basis. Himwich, H. E., Himwich, W. A., and Etsten, B. [*Trans. Am. Neurol. Assoc.*, **72**, 189 (1947).]

A motion-picture of patients receiving 1 per cent. pentothal sodium intravenously showed that the anesthesia pattern progressed down the neuraxis from the cerebral hemispheres. Depression of metabolism occurred earlier in the cerebral hemispheres and was more profound than in the rest of the brain. Most of the clinical changes could be explained by a descending metabolic depression of the neuraxis, but specific affinity for certain cerebral areas was apparently also effective.

MARION HORN PESKIN (Chem. Abstr.).

Curare and Curare-like Compounds. Comroe, Julius H., jun., and Dripps, Robert D. [*Surg. Clin. North Am.*, 1947, 1575–82.]

A review, with 24 references, of the physiological action, clinical use, toxicity and antidotes of curare, *d*-tubocurarine chloride, and the curare-like compounds: β-erythroidine, dihydro-β-erythroidine, quinine methochloride, and myanesin.

MARION HORN PESKIN (Chem. Abstr.).

An Effect of Curare on the Central Nervous System. Case, Theodore J., and Funderburk, Wm. H. [*Trans. Am. Neurol. Assoc.*, **72**, 195–6 (1947).]

A conditioned response established in cats paralyzed with curare could later be elicited only under partial curare paralysis, never after recovery from it unless eserine was given. It is suggested that acetylcholine may be involved in the mechanism of the central effect of curare.

MARION HORN PESKIN (Chem. Abstr.).

The Effect of Certain Quaternary Ammonium Ions upon Frog Nerve. (1) *Lorente de No, Rafael.* [*J. Cellular Comp. Physiol.*, **33**, *Suppl.*, 3–165 (1949).]

The quaternary ammonium ions included all possible combinations of Me, Et, and $-CH_2CH_2OH$ groups; ions containing 3 Et groups plus Ph, $PhCH_2CH_2-$ $AcOCH_2CH_2-$, or 1 member of the series Pr to hexyl; ions containing 4 Pr or 4 Bu groups. Often substitution of 1 group produced a radical change in the effect of the ion on frog nerve. In 0·11 M solutions of Me_4N, $EtMe_3N$, and $Me_2(HOCH_2CH_2)_2N$ ions nerve fibers maintained their membrane potential at the normal level and became inexcitable as they do in other inert Na-free media. Only slight differences were observed in solutions of choline chloride. A number of the ions exerted a depolarizing action on nerve fibers. In the series with 3 Et groups the depolarizing action increased with the length of the C chain of the 4th group. Although Me_4N and Et_4N ions did not depolarize nerve, Pr_4N and Bu_4N ions were powerful depolarizers. Nerves in 0·11 M Et_4NCl maintained their membrane potential at the same level as nerves in Ringer solution; group A fibers lost their excitability as in other Na-free media, but fibers of slow conduction remained excitable as long as in Ringer solution. The latter fibers were designated " Et " fibers. Certain modifications of the action potential of " Et " fibers and of the electrotonic potential of A fibers indicate that Et_4N ions can take part in chemical reactions that belong to the normal physiology of nerve. The excitability of " Et " fibers kept in a Na-free medium could be restored by ions containing 2 or more Et groups. This ability did not have a direct relation to the effect on the resting membrane potential, although all restoring ions increased the L fraction of the membrane potential. Fibers that had lost excitability in choline solution recovered when $Et_3(HOCH_2CH_2)N$ ions were added. The effectiveness of restoring ions increased with the number of $HOCH_2CH_2-$ and more so with the number of Et groups in the ions. Et_4N was the best substitute for Na but $PhEt_3N$, $PrEt_3N$, $BuEt_3N$, and $AmEt_3N$ ions were powerful restoring agents. The Et group was not specific since Pr_4N and Bu_4N ions were effective. Hypothesis: Chemical reactions which result in a change of tricovalent N into quadricovalent N participate in the establishment of electric double layers in the nerve membrane.

(II) [*Ibid.*, 167–231.]

Pursuant to the hypothesis stated above, ethylation of piperidine, L (+)–lysine, and histamine gave quaternary ions capable of restoring the excitability of " Et " fibers deprived of Na. The quaternary ions resulting from ethylation of pyridine, niacinamide and coramine were not restoring ions. Ox brains were boiled with 0·1 N HCl and the " lysine fraction " was isolated. Addition of $K_4Fe(CN_6)$ to a N H_2SO_4 solution of this fraction precipitated quarternary ammonium ions. The bases were freed with $CuSO_4$ and $Ba(OH)_2$ and neutralized with HCl. The base (or bases) present (only traces of Na and K), restored to " Et " fibers deprived of Na the ability to conduct impulses and to A fibers the ability to produce impulses after an anodal current had been applied to the fibers. Another similar preparation restored to " Et " fibers the ability to conduct impulses and to A fibers the ability to produce E_1 fluctuations of the electrotonic potential. Presumably the bases extracted from ox brain participate in some of the electrochemical reactions which underlie the value of the resting membrane potential and the production of the nerve impulse.

H. L. MASON (Chem. Abstr.).

Antagonism and Synergism between Narcotics and Sympathomimetic Amines in their Action on Vertebrate Central Nervous System. (I) Waking Action of Sympathomimetic Amines in Respect to Chloral Hydrate and Medinal. Arbuzov, S. Ya. [*Fiziol. Zhur. S.S.S.R.* [*J. Physiol.*), **32**, 695–710 (1946).]

The body-temperature method was used on guinea-pigs to measure the effects of the drugs on the nervous system. The narcotic dosage was 400–500 mgm./kgm.

introduced subcutaneously in isotonic NaCl solution. In chloral hydrate narcosis, phenamine and pervitin have the strongest waking action, followed by ephedrine and sympathol; adrenaline has a very weak effect. In medinal anesthesia the effects are much weaker. The amines also cause a body-temperature rise which appears after the effect of the waking action and which appears regardless of the extent of waking action. In deep narcosis these amines severely decrease the mortality ratio. Phenamine dosage was up to 20 mgm./kgm. pervitin up to 500, ephedrine and sympathol up to 100.

(*II*) *Changes of the Latent Reflex Time and Body Temperature under Action of Sympathomimetic Amines and the Waking Action of the Latter in Respect to Narcotics.* [*Ibid.*, **34**, 645–56 (1948).]

In experiments with male rabbits, with Zakusov's method (*Ibid.*, **23**, 276 (1937)) for determination of the latent reflex time on the flexor reflex of hind leg, the following was established. The minimum dose for change of the latent reflex time was adrenaline 5×10^{-6}, pervitin 0·00005, phenamine 0·0001, ephedrine 0·002, and sympathol 0·01 gm./kgm. Tested against chloral hydrate and Na barbital, all of the above were antagonistic to chloral hydrate action (pervitin being strongest, sympathol weakest). Antagonism to barbital was not shown by pervitin and on repeated administrations some synergism was observed. Adrenaline showed antagonism at 1 : 1 dose ratio, while the remaining amines were intermediate. Changes of body temperature by sympathomimetic amines are analogous; in all cases temperature rises simultaneously with lengthening of the latent reflex period. Although adrenaline in a single injection shows the least effect against chloral hydrate narcosis, repeated injections increase its "waking" effect and make it approach phenamine in this respect. Combination of phenamine with acetylcholine, physostigmine and prostigmine leads to more pronounced shortening of chloral hydrate narcosis; with barbital the above combinations actually increase the duration of narcosis, and only a single injection of phenamine-atropine leads to noticeable denarcotization. G. M. Kosolapoff (Chem. Abstr.).

The Influence of Narcotics on Cholinesterase Activity. IV, Comparison of Narcotic Strengths of Narcotics with their Hindering Activity on Cholinesterase Activity. Mikhel'son, M. Ya. [*Fiziol Zhur. S.S.S.R.* (*J. Physiol.*), **32**, 745–56 (1946); *cf. C. A.*, **41**, 3496*d*; **39**, 129^2).]

Approximately the same (30–70 per cent.) hindering of blood cholinesterase activity is produced by isonarcotic doses of the following: EtOH ($3\cdot5 \times 10^{-1}$), antipyrine ($5\cdot3 \times 10^{-2}$), urethane ($3\cdot4 \times 10^{-2}$), pyramidone ($1\cdot3 \times 10^{-2}$), chloral hydrate (6×10^{-3}), phenobarbital ($8\cdot7 \times 10^{-3}$), acetanilide ($7\cdot4 \times 10^{-3}$), phenacetin ($2\cdot8 \times 10^{-3}$), bromural ($4\cdot5 \times 10^{-4}$), thymol ($6\cdot5 \times 10^{-4}$ chloretone (6×10^{-3}). The hindering action of chloretone and thymol is just as strong in concentrations 4–5 times higher than narcotic concentrations. The experiments were performed with frogs. G. M. Kosolapoff (Chem. Abstr.).

Theory of Narcosis. Investigation on the Reaction of Several Narcotics on the Ion Permeability of Red Blood Cells with Regard to the Permeability Theory of Narcosis. Liebe, Hermann. [*Arch. ges. Physiol.* (*Pflugers*), **250**, 295–302 (1948).]

The influence of $CHCl_3$, amyl alcohol, octyl alcohol, ethylurethane, phenylurethane, and thymol on the ionic exchange of SO_4^- for Cl^- in beef, horse and human red cells was examined. Only phenylurethane (concentration = 0·006 M) was able to bring about a reversible decrease in permeability of beef and horse red cells; but it was ineffective on human red cells. $CHCl_3$, amyl alcohol, ethylurethane and thymol in high concentration increased permeability by damage to membranes. Octyl alcohol had no effect because of low water solubility. The relation between pore diameter, molecule volume, lipide solubility and surface tension are not so simply related as to clarify the reaction mechanism of narcotics. R. F. R. (Chem. Abstr.).

Detection of Narcotics in Biological Material. Fischer, R., and Chalupa, L. [*Mikrochemie ver. Mikrochim. Acta*, **34**, 257–68 (1949) (*in German*).]

For the purification of derivatives of barbituric acid; morphine and dilantin, the systematic use of absorbents such as fibrous alumina, MgO and various organic solvents marks an improvement over the conventional Stas-Otto procedure because the work is simpler, the losses less, and the purity of the isolated narcotic greater. Microsublimation often helps to obtain crystals, and the determination of the m.p. of derivatives, eutectic temperatures and crystallographic constants often aid in the identification. W. T. HALL (Chem. Abstr.).

The Action of Diallylbarbituric Acid and of Scopolamine on the Spinal Reflexes of the Decapitated, the Decerebrated, and the Decorticated Cat. Teuchmann, Jan. [*Arch. intern. Pharmacodynamie*, **79**, 257–62 (1949).]

The same dose of diallylbarbituric acid is needed to suppress spinal reflexes in the spinal, decerebrated, or decorticated cat preparation. Scopolamine is effective only in the latter case. M. L. C. BERNHEIM (Chem. Abstr.).

Metabolism of Radio-active Pentobarbital in Mice. Roth, Lloyd J., Leifer, Edgar, Hogness, John R., and Langham, Wright H. [*J. Biol. Chem.*, **178**, 963–5 (1949).]

When Na pentobarbital (I) labelled with C^{14} was injected intraperitoneally into mice, 80 per cent. of the radio-activity was recovered: 78 per cent. in the urine, 2 per cent. in the feces, and none in expired CO_2. Filter paper chromatograms of the urine indicate the presence of 5 radio-active metabolites, none of which is urea of (I). J. P. DANEHY (Chem. Abstr.).

The Effect of Pentobarbital on Aerobic Phosphorylation in (Rat) Brain Homogenates. Eiler, John J., and McEven, W. K. [*Arch. Biochem.*, **20**, 163–5 (1949).]

Pentobarbital (I) inhibits the generation of high energy phosphate bonds only to the extent that it interferes with the utilization of O. By using up to $7{\cdot}5 \times 10_{-4}$ M concentration of (I) and pyruvate, succinate and fumarate as substrates, E and Mc find the O uptake inhibition in the presence of pyruvate and fumarate, with proportional phosphate uptake inhibition in the presence of the former. (I) does not interfere with the aerobic phosphorylation of succinate. The above results indicate that more than one high energy phosphate bond is generated in the oxidation of succinate to fumarate. I. Z. R. (Chem. Abstr.).

Effect of Phenobarbital on the Action of Insulin. Johlin, J. M. [*Endocrinology*, **40**, 426–9 (1947).]

The simultaneous administration of Na phenobarbital and subconvulsive doses of insulin to rabbits causes the animals to convulse, lowers the level of blood sugar below that resulting from the insulin alone, and prolongs the return of blood sugar to normal. L. E. GILSON (Chem. Abstr.).

Effect of Phenobarbital on Oxygen Consumption of Brain Slices. Westfall, B. A. [*J. Pharmacol. Exptl. Therap.*, **96**, 193–7 (1949).]

Na phenobarbital in concentrations of 0·2–0·5 mgm. per cent. slightly increased the O consumption of slices of rat cerebral cortex; 10 mgm. per cent. or more decreased O consumption. L. E. GILSON (Chem. Abstr.).

Respiratory and Electrical Signs in Barbiturate Intoxication. Denny-Brown, D., Swank, R. L., and Foley, J. M. [*Trans. Am. Neurol. Assoc.*, **72**, 77–82 (1947).]

Electroencephalographic patterns and respiratory response to CO_2 proved reliable in defining the depth of Na amytal narcosis in dogs, and are being investigated for similar use in man. Breathing of 10 per cent. O_2 stimulated respiration of dogs in early narcosis, and continued to do so after CO_2 was ineffective; however late in deep narcosis, 10 per cent. O_2 depressed breathing and killed the animal. Respiratory depression was produced by 100 per cent. O_2 at various stages of narcosis in the dog but not in man. Various analeptics (coramine, caffeine, benzedrine, aminophylline, metrazole, picrotoxin) became less effective respiratory stimulants as narcosis deepened. MARION HORN PESKIN (Chem. Abstr.).

The Effect of Barbiturates and Other Substances on Motion Sickness in Dogs. Noble, R. L. [Can. J. Research, **26E**, 283–94 (1948); *cf. Ibid.,* **24E**, 10 (1946).]

Barbiturates and other substances are able to prevent motion sickness in dogs. There appears to be little correlation between this property, anesthetic and hypnotic activities, and chemical structure. Thio compounds had protective activity, but often elicited toxic effects. In some cases the free acids were more effective than their Ca or Na salts. The protective effect of the compounds was compared with that of ethyl-3-methylallylthiobarbituric acid (I) which is active in human beings. In dogs, however, other compounds were more effective, particularly ethylmethylcyclopropylmethylbarbituric acid. As a rule, substances with longer unsaturated side chains and substituted Me groups showed more activity. Pyridoxine and hyoscine, effective in controlling human vomiting, were devoid of activity in the test animals. Bulbocapnine possessed only half of the activity of (I), but produced additive effects with (I). KURT I. ALTMAN (Chem. Abstr.).

The Metabolism of Barbiturates. Maynert, E. W., and Van Dyke, H. B. [J. Pharmacol Exptl Therap. **96**, *Pt.* 2; *Pharmacol. Revs.,* **1**, 217–42 (1949).]

Spinal Cord Depressant Drugs. Berger, F. M. [Ibid., **243**, 78.]

The Pharmacological Activity of Adrenaline and Related Dihydroxyphenylalkylamines. Lands, A. M. [Ibid., 279–309.]

L. E. GILSON (Chem. Abstr.).

Influence of Hematoporphyrin on the Action of Convulsive Poisons (Coramine, Metrazole, Strychnine). Rodewald, Wilhelmine. [Arch. exptl. Path. Pharmakol., **205**, 434–6 (1948).]

In mice and frogs hematoporphyrin injected 5–30 minutes previously greatly increased the sensitivity to the convulsant action of coramine. It had no significant influence on the action of metrazole in mice. It slightly decreased sensitivity to strychnine in mice kept in the dark, but had no influence on their sensitivity in diffuse daylight. L. E. GILSON (Chem. Abstr.).

Locus of Action of Metrazole and Coramine. (I) Convulsant and Arousing Action. Hahn, Fritz. [Arch. exptl. Path. Pharmakol., **205**, 552–62 (1948).]

The action is through the central nervous system. Metrazole acts on the higher nervous centers and coramine on the lower, especially the medulla and spinal cord.

(II) Action on Blood Pressure. Hahn, Fritz, and Simon, Kurt. [Ibid., 563–71—*Discussion.*]

(III) Action on the Central Parasympathetic System. Hahn, Fritz. [Ibid., 572–81.]

Coramine strongly stimulates salivary secretion. The effect of metrazole is much weaker. Metrazole is a relatively weak stimulant of the parasympathetic system.

(IV) Action on the Central Sympathetic System. [Ibid., 582–9.]

The two drugs are about equally potent as stimulators of the sympathetic system as judged by their elevating effect on blood sugar and inhibiting action on intestinal contractions. L. E. GILSON (Chem. Abstr.).

Action of Metrazole in Convulsive Doses. Murray, Maynard, Hoffmann, C. Rowell, and Scroggins, Fred R. [J. Am. Pharm. Assoc., **38**, 300–1 (1949).]

Metrazole (I) fits are not accompanied by a rise in blood guanidine as are spontaneous convulsions in idiopathic epileptics; this indicates a difference in chemical reaction. Convulsions caused by (I) do not cause changes in the ovaries or endometrium of female rabbits; this indicates that this therapy, although effective in involutional melancholia, does not act in any demonstrable way on the anterior pituitary or the gonads. DAVID B. SABINE (Chem. Abstr.).

Application of Myanesin in Neurology. Schlesinger, Edward B. Drew, A. Leslie, and Wood, Barbara. [*Trans. Am. Neurol. Assoc.*, **73**, 94–100 (1948).]

Myanesin, which depresses the brain stem and spinal cord, has been found ephemerally effective on intravenous injection for ameliorating tremor, rigidity and spasticity in Parkinsonism and other diseases.

MARION HORN PESKIN (Chem. Abstr.).

Dibenamine Therapy in Certain Psychopathologic Syndromes. Rockwell, Fred V., and Oskar Diethelm. [*Trans. Am. Neurol. Assoc.*, **73**, 127–31 (1948).]

N, N-Dibenzyl-β-chloroethylamine (dibenamine), given orally in doses of 250 mgm. three times a day, produced mild to marked therapeutic benefit in 50 patients suffering from anxiety, fear, panic, resentment, or anger. The chief benefit was alleviation of acute anxiety states so that chronic mental disorders could be treated by psychotherapy. The drug blocks and reverses excitatory adrenergic responses (primarily on smooth muscle and glands) and does not influence other effects of adrenaline. Although moderately toxic, it can be given safely over long periods with suitable precautions. Attempts at intravenous administration led to many toxic reactions, including nausea, vomiting, confusion, and emotional lability.

MARION HORN PESKIN (Chem. Abstr.).